Presented to
The Library
of the
University of Toronto
by
Professor Bain

Digitized by the Internet Archive
in 2010 with funding from
University of Toronto

http://www.archive.org/details/chemicalage30newy

C

CHEMICAL AGE

Vol. 30 A CONSOLIDATION OF THE CHEMICAL ENGINEER AND CHEMICAL AGE No. 1

Entered as second class matter May 8, 1917, at the Post Office at New York, N. Y., under the Act of March 3, 1879.

LLOYD LAMBORN, *Editor*

BOARD OF EDITORIAL ADVISORS

J. S. ABBOTT, Secretary, Institute of Margarin Manufacturers

HENRY HOWARD, Grasselli Chemical Co., Chairman, Executive Committee, Manufacturing Chemists' Association of the United States.

G. A. O'REILLY, Vice-President, Manager Foreign Trade and Business Research Department, Irving National Bank

GEORGE H. RASCH, President, Morris Fertilizer Co., General Manager, By-Products Departments, Morris & Co.

NEW YORK, JANUARY, 1922

CONTENTS

345659
17.1.38

FRONT COVER: HENRY HOWARD, PRESIDENT, AMERICAN INSTITUTE OF CHEMICAL ENGINEERS

EDITORIALS. Page 22

GASOLINE FROM OIL SHALE. Substitutes for Gasoline. Decreasing Domestic Petroleum Output Hastens the Development of Oil Shale as a Source of Automotive Fuel. Research in Oil Shale Utilization at Columbia University. By Dr. Ralph H. McKee, Professor of Chemical Engineering, Columbia University. Illustrated. Page 1

THE ASSOCIATED TECHNICAL SOCIETIES OF DETROIT. Page 4

HEAT STANDARD OF GAS MEASUREMENT IN NEW YORK CITY. Page 4

THE WAR AGAINST INSECTS. The Insecticide Chemist and Biologist in the Mitigation of Plant Pests. By Dr. L. O. Howard, Chief, Division of Entomology, U. S. Department of Agriculture. Illustrated. Page 5

ENGINEERS' LICENSE LAW IN NEW YORK AND PENNSYLVANIA. Page 6

CANADIAN INSTITUTE OF CHEMISTRY. A Review of the Growth of the Idea. Its Organization, Functions and Future. By Harold J. Roast, F.C.S., F.C.I.C., Secretary, Canadian Institute of Chemistry. Illustrated. Page 7

PRODUCTS OF LOW TEMPERATURE DISTILLATION OF COAL. By Dr. Walter Runge, Vice-President and General Manager, The Bregeat Corporation of America. Page 29

COLLEGE OF ENGINEERING OF THE NEWARK TECHNICAL SCHOOL. Description of a Factor of Increasing Importance to the Industries of Northern New Jersey and an Encouragement to Technical Institutions to Make More Efficient Their Service to Local Industry. Natural Selection Applied by the Institution to Young Men Who Seek Technical Education While They Work. Illustrated. Page 11

ADJUSTMENT IN THE PACKING INDUSTRY. Page 14

APPLICATION OF NEW KNOWLEDGE TO INDUSTRY. Forest Products Laboratory Is Hampered in This Service by Lack of Funds. Page 15

INDUSTRIAL USES OF GAS MASKS. By H. Foster Bain, Director, U. S. Bureau of Mines. Page 16

NEW JERSEY CHEMICAL SOCIETY. Page 16

SALT PANS. Some Standard Proportions for Vacuum Pans Used in the Salt Industry. By W. F. Downing, Jr. Illustrated. Page 17

COGITATIONS ON THE CHEMIST. Page 18

SILICATE OF SODA. Its Function in the Cleansing Process. Expansion of Its Use as a Detergent. By James G. Vail, Chemical Director, Philadelphia Quartz Co. Page 19

IMPARTING TO VEGETABLE FIBRES THE CHARACTERISTICS OF WOOL. Page 20

CHEAP OXYGEN. A Consideration of Its Application to Chemical Processes in Metallurgy. By Anson G. Betts, Chemist and Mining Engineer. Page 21

NEW CATALYST IN LEAD ARSENATE MANUFACTURE. Page 24

JINGLES OF SCIENCE. Page 24

COLORED NITRO CELLULOSE COMPOSITIONS. Page 24

AMERICAN INSTITUTE OF CHEMISTRY. Page 25

IMPROVED PROCESS OF MARGARIN MANUFACTURE. By William T. Ashby. Page 26

ELECTRIC HEAT FOR THERMAL PROCESSES. By E. F. Collins, Industrial Heating Engineer, General Electric Co. Illustrated. Page 27

DU PONT FELLOWSHIPS. Page 28

SOME PHASES OF CHEMICAL COST ACCOUNTING. II. By C. B. E. Rosén, M.B.A., C.P.A., of Charles F. Rittenhouse & Co. Page 29

AEROPLANE VIEW OF MASSACHUSETTS INSTITUTE OF TECHNOLOGY. Page 31

CHEMICAL WARFARE. Page 32

SIGMA XI. A Society for the Promotion of Scientific Research. Page 33

THE BACTERIOLOGY OF SAUER KRAUT AND PICKLES. By Dr. Edwin LeFevre, Chemist, Microbiological Laboratory, Bureau of Chemistry, U. S. Department of Agriculture. Page 34

CONVERSION OF PETROLEUM RESIDUUM INTO GASOLINE. The Address of Acceptance of Dr. William M. Burton, President, Standard Oil Co. of Indiana, on the Award of the Perkin Medal by the American Section of the Society of Chemical Industry, January 13, 1922, at Rumford Hall, New York, for Distinguished Service in Applied Chemistry. Page 35

UTILIZATION OF WASTE SLATE AS A FILLER. By Oliver Bowles, Mineral Technologist, U. S. Bureau of Mines. Page 37

SCIENTIFIC TRAINING AND SALARIES IN THE BUREAU OF STANDARDS. Page 38

SULFURIC ACID MANUFACTURE WITHOUT CHAMBERS AND TOWERS. Illustrated. Page 39

MARGARIN AND VITAMINES. Page 41

SYNTHETIC GOLD. Page 42

GAS WARFARE CONDEMNED. Page 42

TREATMENT OF WATER FOR STEAM MAKING. By Julian S. Simsohn, Consulting Chemical Engineer. Page 43

PERSONAL ITEMS. Page 47

INDUSTRIAL NOTES. Page 48

Copyright, 1922, by McCready Publishing Company

Published monthly by the McCready Publishing Co., 118 East 28th Street, New York

ROBERT H. McCREADY, *President* E. J. MORDAUNT, *Treasurer* C. W. BUTTERWORTH, *Advertising Manager*

Subscription Prices: United States, Mexico, Cuba, Porto Rico, Hawaii or the Philippines, $3.00 per year; Canada, $3.50; Foreign, $4.00; Single Copy, 50c.

TP
1
C32
v.30

REG.U.S. CECO PAT.OFF.

Aluminum Valves

are used widely for the handling of such materials as nitric acid, acetic, citric and other organic acids, fruit juices, etc.

They are of the well-known patented **CECO** type, body being split to make all parts accessible.

Seat is removable and reversible, insuring long life and satisfactory service. Same valve can be mounted in either angle or straightway position. Threads all enclosed and grease-packed.

All sizes available made of aluminum and various aluminum alloys for various purposes.

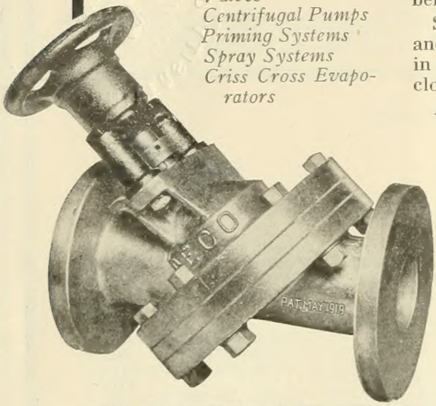
We also make a centrifugal pump of these aluminum alloys to serve with the valves.

Both valves and pumps are also made of hard lead, bronze, iron, and other materials.

Write our nearest office for literature and prices.

Products include:

Valves
Centrifugal Pumps
Priming Systems
Spray Systems
Criss Cross Evaporators



CHEMICAL EQUIPMENT COMPANY
2457-59 South Western Avenue, Chicago, Ill.

New York: W. B. Connor, Inc., 90 West Street
Boston: W. B. Connor, Inc., 10 High Street
Atlanta: Murphey-Rountree Co., Hurt Bldg.

CECO THE ONLY ALUMINUM VALVE ON THE MARKET CECO

Seven Years Experience

—as Consulting Chemist and Engineer has convinced this expert that for the handling and circulation of fruit juices, vinegars and related food products there is no safe substitute for

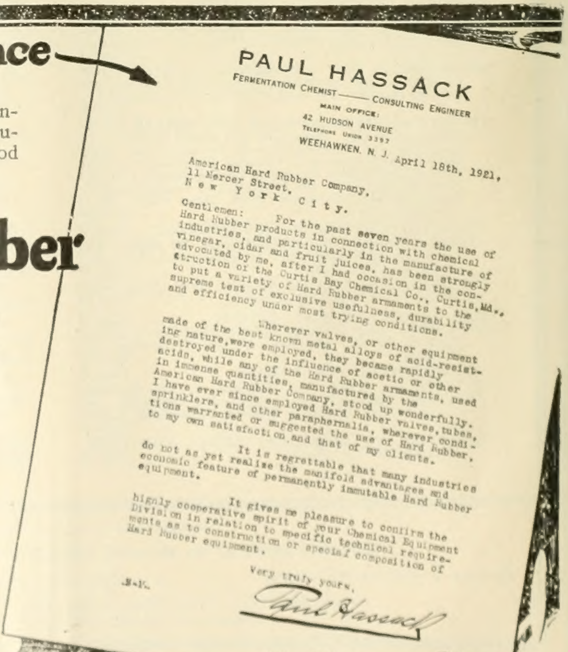
ACE~Hard Rubber

Pumps, Pipe, Fittings, Tanks and Utensils

REG.U.S. A PAT.OFF.

What is true in food products industries holds equally well in many chemical fields. The problem of avoiding contamination of costly solutions, plus the economy of reducing overhead through absence of corrosion, immediately suggests Ace Hard Rubber Equipment.

Why not ask our Chemical Laboratories for a report on Ace Hard Rubber as applied to your own individual chemical handling problem?



PAUL HASSACK
FERMENTATION CHEMIST —— CONSULTING ENGINEER
MAIN OFFICE:
42 HUDSON AVENUE
TELEPHONE UNION 3397
WEEHAWKEN, N. J. April 18th, 1921,

American Hard Rubber Company,
11 Mercer Street,
New York City.

Gentlemen: For the past seven years the use of Hard Rubber products in connection with chemical industries, and particularly in the manufacture of vinegar, cidar and fruit juices, has been strongly edvocuted by me, after I had occasion in the construction of the Curtis Bay Chemical Co., Curtis, Md., to put a variety of Hard Rubber armaments to the supreme test of exclusive usefulness, durability and efficiency under most trying conditions.

Wherever valves, or other equipment made of the best known metal alloys of acid-resisting nature, were employed, they became rapidly destroyed under the influence of acetic or other acids, while any of the Hard Rubber armaments, used in immense quantities, manufactured by the American Hard Rubber Company, stood up wonderfully. I have ever since employed Hard Rubber valves, tubes, sprinklers, and other paraphernalia, wherever conditions warranted or suggested the use of Hard Rubber, to my own satisfaction and that of my clients.

It is regrettable that many industries do not as yet realise the manifold advantages and economic feature of permanently immutable Hard Rubber equipment.

It gives me pleasure to confirm the highly cooperative spirit of your Chemical Equipment Division in relation to specific technical requirements as to construction or special composition of Hard Rubber equipment.

Very truly yours,

Paul Hassack

S-F.

American Hard Rubber Company ~ 11 Mercer Street New York, N.Y.

CHEMICAL AGE

A CONSOLIDATION of THE CHEMICAL ENGINEER and CHEMICAL AGE

LLOYD LAMBORN, *Editor*

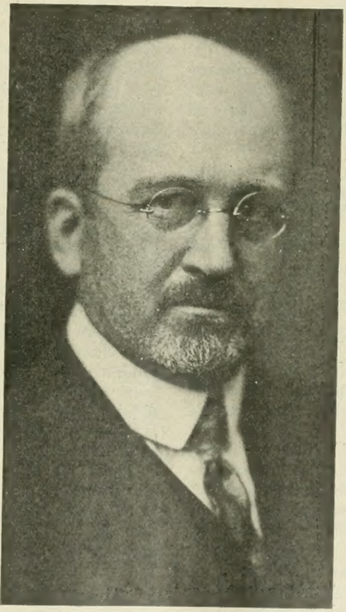
VOLUME 30 NEW YORK, JANUARY, 1922 NUMBER 1

Gasoline from Oil Shale

Substitutes for Gasoline. Decreasing Domestic Petroleum Output Hastens the Development of Oil Shale as a Source of Automotive Fuel. Research in Oil Shale Utilization at Columbia University.

By Dr. Ralph H. McKee

Professor of Chemical Engineering, Columbia University



DR. RALPH H. McKEE

Professor of Chemical Engineering, Columbia University

GASOLINE briefly may be defined as a hydro-carbon distillate, usually of petroleum, 90 per cent of which boils below 374° F., and all of which boils below 437° F. It has a density of less than 50° Bé. To be a commercial product it must be of slight color and free from certain types of impurities.

Before considering oil shale as a source of gasoline I want to touch upon the technology of petroleum - gasoline production. Twenty years ago all the gasoline used was obtained from the crude, low-boiling distillate of petroleum. This distillate was treated with concentrated sulphuric acid to remove coloring matter, ill-smelling compounds, certain substances commonly called unsaturated compounds and small amounts of certain basic constituents. Following the acid-wash was treatment with caustic soda solution, whereupon the treated crude distillate was redistilled and a very fine quality of product was obtained.

Pennsylvania petroleum is the highest quality American petroleum and yields readily high-quality gasoline, but with decreased output and the influx of lower-grade oils from Ohio, Canada, Mid-Continent and the West, it was found that they did not yield in quantity or quality the gasoline yielded by Pennsylvania crude. Meantime demand for gasoline, due to the wide use of the internal combustion engine, was increasing; accordingly lower-grade gasolines began to come in the market. They carried some of the higher-boiling kerosene fraction, some color and some of the unsaturated compounds which give a strongly odored product. With lowered standards came increase in the quantity available but even under these circumstances demand has increased faster than the supply. Resort has been had to other products to supply the deficiency with the result that three new petroleum products, viz., casinghead gasoline, natural gas condensate and "cracked" gasoline, as well as substitutes of quite different origin, have arisen.

"Cracked" Gasoline

When a higher-boiling petroleum, of the type of low-priced fuel oil or gas oil, is heated to a temperature around 700° F. decomposition ensues with the separation of carbon and the formation of light-boiling constituents of the type of gasoline and kerosene. This process is called "cracking" and the lower-boiling of the commercial products thus made is known as "cracked" gasoline. Cracked gasoline carries up to 40 per cent of unsaturated compounds. Formerly a gasoline carrying as much as 5 per cent of unsaturated constituents was not desirable for use in an explosive engine. Today much of the gasoline sold is a mixture of cracked gasoline of 40 per cent unsaturated content with straight distillate gasoline of low unsaturated content. In New York it is not uncommon to have put in one's car a gasoline carrying 20 per cent of unsaturated constituents, which means that such gasoline on standing and in contact with air discolors and separates, after a time, a small amount of brown tar-like deposit. The automobile of a few years ago would not run on present-day gasoline. With the certain increase in the content of unsaturated compounds, we must look to the engine designer to keep up with the changes in the type of fuel available.[*]

Dr. William M. Burton

The cracking process most largely used is that devised by Dr. William M. Burton, a chemist now president of the Standard Oil Co. of Indiana and the recipient, January 13, of the Perkin Medal, awarded by the American Section of the Society of Chemical Industry for notable attainments in the industrial applications of chemistry. The Burton process is used by Standard Oil Companies and licensees with an approximate daily yield of two million gallons of gasoline.

Burton starts, as do all cracking processes, with a cheap petroleum residuum, preferably of the Pennsylvania or mid-continent types. The distinctive feature of his process is that he heats under a pressure of 75 pounds and does not relieve this pressure until after the vapors have passed through the condenser. The oil is heated by direct fire in a steel still tank at a temperature varying during the process but which averages about 700° F. Any cracking process is handicapped by the deposition of coke on the bottom and sides of the still, the Burton process suffering severely in this respect. The original patent claims that the product is free from unsaturated compounds. However, the product as at present made does carry a considerable percentage of unsaturated constituents. The process is fairly cheap to operate but suffers as stated from heavy flinty carbon deposits, high deterioration of stills, danger to operators, and also because the products formed are too unsaturated to be of the highest grade.

Rittman and McAfee

Other workers have attempted to get away from the troubles of the Burton process, particularly the heavy carbon separation and unsaturated character of the product. Rittman while a graduate student at Columbia University developed a process by which the cracking is effected in the vapor phase instead of as a liquid. His apparatus consists of externally heated vertical pipes through which the vapors are passed under pressures which may be as high as 300 pounds and at a temperature of 700° F. By reason of the reaction being in the gaseous phase instead of the liquid, the amount of carbon deposited is small but the products, like those of Burton, are partially unsaturated.

Dr. McAfee, like Dr. Rittman, a Columbia graduate, by a process which has been carried out commercially, avoids the use of pressure and obtains a sweet-smelling, strictly saturated gasoline by a chemical reaction of quite different type from that of Burton or Rittman. He works at ordinary pressure and at quite moderate temperature, say 500° F., heating the oil to be cracked with a few per cent of its weight of aluminum chloride. Aluminum chloride reacts with the oil to form a coke-like carbon and low-boiling hydrocarbons suitable for motor fuel. The uneconomic recovery of the aluminum chloride for re-use has been a commercial handicap, the selling price of gasoline not being high enough to permit discarding the chemical after one use.

Casinghead Gasoline

Many oil wells yield at the same time considerable gas as well as oil. This gas is formed in part by the evaporation of the same volatile constituents as are present in petroleum, and which on compression yield low-boliing liquids of naturally high volatility. Gasoline thus obtained from the gas issuing from the casing of an oil well is called "casinghead" gasoline. Its volatility is so high and its density so low that it can be mixed with higher-boiling constituents such as kerosene and the resulting product appears to be a gasoline of the ordinary type.

Casinghead gas may be bubbled through a high-boiling distillate such as "gas oil" and the resulting solution of gas in the oil distilled whereby the gasoline is recovered and the absorbent oil is available for re-use. Recovery of gasoline from natural gas also may be effected by the use of charcoal as by Burrell's process[*] or by the use of silica gel which promises to displace gas oil and Burrell's carbon for this purpose.

Alcohol Blends

In America we have had gasoline cheap and in comparative abundance; this has not been the case the world over. We consider 40 cents a gallon high, but most of the world would welcome gasoline at 60 cents and call it cheap. Europe uses large amounts of benzol, a by-product of coke and gas plants. The "black strap" molasses of raw sugar refining yields on fermentation alcohol which is used in Cuba extensively as a substiture for gasoline. Natal of South Africa has an abundant supply of alcohol from the same source. High price of gasoline in that part of the world has made possible a commercial product called "natalite" which is a mixture of alcohol with about 45 per cent of ether. In America there has been but one commercial attempt to supply a gasoline substitute, viz., alcogas. These substitutes have their respective advantages and disadvantages.

In Europe benzol is decidedly cheaper than gasoline, but it is harder to start the engine and carbon deposition in the cylinder is greater than with gasoline. The shale motor spirit of Scotland often runs 60 per cent of unsaturated constituents and accordingly is strongly odored, somewhat discolored and cannot be stored for any considerable time without loss of quality. The alcohol blends of Cuba and Natal, particularly that of Natal which contains ether, give trouble owing to their great tendency to make the engine "knock," and also some trouble due to the difficulty of obtaining them free from acetic acid with its corrosive action on containers. Addition of aniline will reduce and even remove this trouble but its price, $1.50-$2.00 per gallon, militates against its use.

The alcogas is a more complex material than the substitutes used in other countries, consisting approximately of one-third benzol distillate (principally benzol and totuol), one-third alcohol products, alcohol and ether and one-third petroleum distillate, principally gasoline. The amount of ether required to easily start the engine varies with the season—in winter 10 per cent and in summer 5 per cent. The great advantage of this substitute over gasoline is freedom from carbonization in the cylinders, which means ordinarily a greater mileage per gallon than with gasoline, viz., 11 per cent. On the other hand the price of the product has been kept above that of gasoline, a handicap arising from variation from time to time in the supply and price of each of the three ingredients.

Future Automatic Fuel Supplies

Prospect of increased supply of petroleum from American wells is nil. The U. S. Geological Survey and the U. S. Bureau of Mines not only show that production approximately is at its peak and that within a few years, probably within three years, output of wells in the United States will begin to decline, but that we should not expect to find any new petroleum fields in the United States. In the past, as at present, the United States furnished approximately two-thirds of the world's production, but we are consuming more than we are producing. In 1919 we imported from Mexico 53 million barrels, in 1920 106 million barrels and in 1921, slightly more than in 1920, amounting annually to about 60 per cent of the total Mexican production of petroleum. Furthermore, the Mexican and Texas fields are of the short-lived type and already in some places are yielding salt water instead of petroleum.

---

[*] Adapted from Dr. McKee's address on "Gasoline from Oil Shale," delivered before the Franklin Institute, Philadelphia, Pa., on January 12, and soon to be presented in full in the *Journal of the Franklin Institute.*

[*] "The Charcoal Method of Gasoline Recovery," by G. A. Burrell, G. G. Aberfell and C. L. Voress. CHEMICAL AGE, Sept., 1920.

Utilization of Oil Shale— Research at Columbia University

Four years ago a careful canvass showed that relatively little was known about the fundamental factors essential to a successful shale oil industry. For example, almost nothing was known regarding the heat of reaction by which oil is formed from the organic material of the shale; likewise as to specific heats and latent heats, or of the chemical reactions that control its formation. In the thought that shale utilization eventually would become an important industry and that knowledge of these fundamental factors were essential to its proper development, we undertook their study at Columbia University. Since that time I have had four graduate students working on various parts of these problems, which work, while far from complete, has yielded results of the utmost importance. Methods used and data obtained I have not time to discuss; I can give only the results.

One of the most important factors entering into the design of a proper shale retort is knowledge of the amount of heat absorbed or evolved in the formation of oil from the organic matter of the shale. One of our men devised the first apparatus capable of determining directly this factor, and found that heat was absorbed in the process and that the amount of heat absorbed was nearly the same for shales from different sections, amounting in general to about 450 calories per gram of oil and gas produced, or 160 B.T.U. per pound of average shale retorted.

It has been thought generally that the organic matter in shale decomposed on heating to form the oil as the primary products of decomposition. Researches in our Chemical Engineering Department show that this is not the case, but that the primary decomposition product is a heavy, solid or semi-solid bitumen and that the oil is formed by a secondary cracking process from this semi-solid bitumen. This cracking process is in the liquid phase similar to that of the Burton process. Further it was found that the decomposition temperature of the shale was quite definite, with 400° and 410° C. as its limits.

The investigations also have shown to be incorrect the belief which has been held by many working on the development of shale oil manufacturing processes, viz., that on heating, gasoline is the first product formed; then on higher heating, kerosene; and on still higher heating, lubricating oils, etc. In other words it was shown that what happens on heating oil shale is that all these products are formed simultaneously by the cracking of the semi-solid bitumen formed first.

Characteristics and Yields of Oil Shales

Oil shales vary not only in yield of oil per ton of shale, but also in type of oil, type and character of minor constituents and also even in the gangue which carries the organic portion. In Scotland are worked shales which yield but 20-22 gallons of oil per ton of shale mined. Large deposits of shales in this country give a much higher yield; the largest of these are the Green River shales of Colorado, Utah and Wyoming. There also are large deposits in Nevada, California, Kentucky, Indiana, Ohio, New Brunswick and Nova Scotia, and smaller deposits, though large enough for commercial exploitation, in many other portions of this continent. There are similar deposits in other parts of the world.

Of those deposits which are likely to be exploited in the next decade, we have variations in yield from 20 gallons to 60 or even 80 gallons per ton. The large deposits of better grade will give about a barrel (42 gallons) of oil per ton of rock. The character of oil produced in some cases is apparently a straight asphalt-type petroleum similar to California well-petroleum. Other shales give a large quantity of paraffin wax of even better quality than that given by the best oil wells of Pennsylvania's history. In the opinion of the writer the average petroleum to be made from American oil shale will resemble most closely the petroleum obtained from the present mid-continent field, such as the Oklahoma oil.

It is not commonly appreciated how large these oil shale deposits are. If we consider only those oil shales which will furnish a barrel (42 gals.) or better of petroleum per ton of shale we have in the Green River section alone in known deposits sufficient to furnish 64 thousand million barrels of petroleum, which amount is eight times larger than the total of the well-petroleum that this country has produced since Col. Drake drilled the first oil well in 1859 at Titusville, Pa. It is more than five times the total production of the world since well-petroleum became commercial sixty years ago.

Cracking Crude Shale Oil

If we are to have gasoline in quantity from oil shale we must make the crude shale oil and then crack it by some one of the oil-cracking processes. If the Burton process is used the gasoline so made will not be one of high quality. It will be strongly odored, will color on standing, and will be inclined to carbonize in the cylinder. However, its heat value per gallon will be greater and accordingly in a properly designed motor it should give a slightly higher mileage than old-fashioned gasoline.

On the other hand, if we used the McAfee process of cracking, we would get stable, water-white, well-keeping, pleasant-odored gasoline of the old type. However, it is to be remembered that the McAfee process is a more expensive type of oil-cracking. At present in Scotland they are using the ordinary scheme of cracking in which considerable quantities of unsaturated compounds are formed, as high as 60 per cent. This motor spirit is generally used and is not considered by the public in that country to be of lower grade than gasoline from well-petroleum.

In distilling most oil shales there is formed simultaneously considerable quantities of ammonia from the nitrogen constituents of oil shale. This ammonia is usually absorbed in sulphuric acid, recovered and sold in the form of ammonium sulphate for fertilizer uses.

A shale oil plant, then, to be successful must be able to handle cheaply and efficiently large quantities of oil shale, distilling it to get the crude oil and ammonia and then crack and refine the crude oil to get a commercial motor spirit. The Scottish plants do this, excepting that they devote considerable attention to the recovery of paraffin wax and it is only the oil left after the wax recovery that is distilled to give lubricating oils, gasoline and burning oils, or is cracked to give shale gasoline.

The Scottish shale retort its one of the vertical-pipe type. When we attempt to handle American oil shales in this retort we find that it gives trouble owing to the pieces of shale coking and adhering to the sides of the retort. This caking of the shale lumps stops the passage of the shale through the retort. For use on most American shales it is quite apparent that we must either modify this Scottish retort or devise retorts on new lines. The Scottish retort is designed with the dual purpose of recovering ammonia from the shale and obtaining oil. With the American shales we have larger amounts of oil, but ordinarily distinctly less ammonia than is produced from the Scottish shale. Therefore, the retort to handle the American oil shale properly must be designed primarily for the production of oil in quantity and of acceptable quality, and only secondarily for the production of ammonia.

There are more than a score of retorting schemes which have been proposed by various American inventors. None of these yet have produced shale oil in large quantities. The most completely developed plant and process are those of the Catlin Shale Products Co., at Elko, Nevado. It has a plant which has produced approximately 100,000 gallons of shale oil. They have a small commercial refinery almost completed and it is probable that the first shale oil and shale gasoline to be marketed in quantity in America will come from this plant. There are several other types of retorts which have been proposed for use in distilling oil shale which probably would, if given proper technical study and trials, develop into commercial processes. At present few believe that any one of these retorts is certain to be practicable when used on a large scale. The ideal process will be one permitting continuous operations on a large scale with minimum labor and with the recovery of good yields of commercially utilizable products.

It is only within the last five years that serious attention has been given to the question of the development of a proper type of retorting still. We have no reason to think but that well before the same length of time now will have elapsed we will have succeeded in obtaining a retorting scheme which can handle with low labor costs efficiently and economically American oil shales.

It is not commonly appreciated with how few men a chemical manufacturing plant can be run. Generally speaking, in such processes labor is a minor factor, but in connection with most of the retorting processes yet proposed labor and power requirements are large and will be approximately one man per barrel per diem of refined product, if mining as well as retorting and refining are included. This is the Scottish labor requirement but we must reduce this labor requirement if we are to have in America a really successful shale oil industry.

I have shown you that the demands for petroleum are increasing in this country at the rate of about 50 million barrels a year. If this continues it will require each year seventy-five new plants, each handling 2,000 tons of oil shale a day and representing an investment of close to a million dollars each to give sufficient oil to meet simply the yearly increase in demand for petroleum. We have no other source of fuel oil or gasoline substitute in prospect which promises to furnish even a minor part of this demand. In other words, we have reason to look forward to the utilization of oil shale as a very profitable chemical manufacturing industry which will rank with our largest industries in its labor and capital requirements and in value of output.

The Associated Technical Societies of Detroit

Technical professional men represented in Detroit by sections of national organizations and by local societies have amalgamated them under the corporate title, "Associated Technical Societies of Detroit," which organization became effective January 1, with the following officers for 1922: Chairman, P. W. Keating; vice-chairman, A. A. Meyer; secretary-treasurer, Walter R. Meier.

Among the societies embraced in this affiliation of interest is the Detroit Section American Chemical Society, American Institute of Chemical Engineers and Detroit Chemists. A central office will be established for conducting the business of the several societies and for the elimination of much of the conflict that has characterized their activities. This amalgamation of technical professional men is claimed to provide an opportunity for public service both for the city of Detroit and for the state of Michigan. The association will take an active interest in all public matters wherein engineering, architectural and technical subjects are an important factor.

Heat Standard of Gas Measurement in New York City

Following long after the acceptance in England of the British thermal unit as the standard of gas measurement instead of the candle power, which is the substitution of the heat unit instead of the light standard, and after an agitation of seven years during which the change generally was made in America, the Public Service Commission of the First District of New York, which embraces the metropolitan area, will concede the victory of applied science over politics in an expected early order authorizing this change.

Outside of New York City in New York State the change from the light to the heat standard in the valuation of gas dates from Jan. 1, 1917, when 585 B. T. Us. were authorized as the standard by the Public Service of the Second District, which has jurisdiction of that area. The obstacle to the adoption of the heat standard in New York City has been the city administration.

The increasing use of gas for household and industrial heating, for which latter purpose over 1,200 different ways of utilizing it have been enumerated, together with the unnecessarily increased cost of its manufacture when measured by the obsolete illuminating standard, was recognized everywhere outside of New York City in the adoption of the heat standard of measurement. Of the total amount of manufactured gas sold, 21 per cent. is for illumination, 54 per cent. for domestic uses other than illumination, 21.67 per cent. for industrial uses and 3.83 per cent. for other uses not classified.

A continuance of compulsory compliance with a standard of quality based on the illuminating rather than the heating efficiency of the gas, is generally agreed to be wasteful of oil and productive of no benefits to general consumers. It is thought that the heat standard expected soon to be authorized in the New York metropolitan area will be [illegible] B. T. Us., which compares with 585 B. T. Us. in force elsewhere in the state.

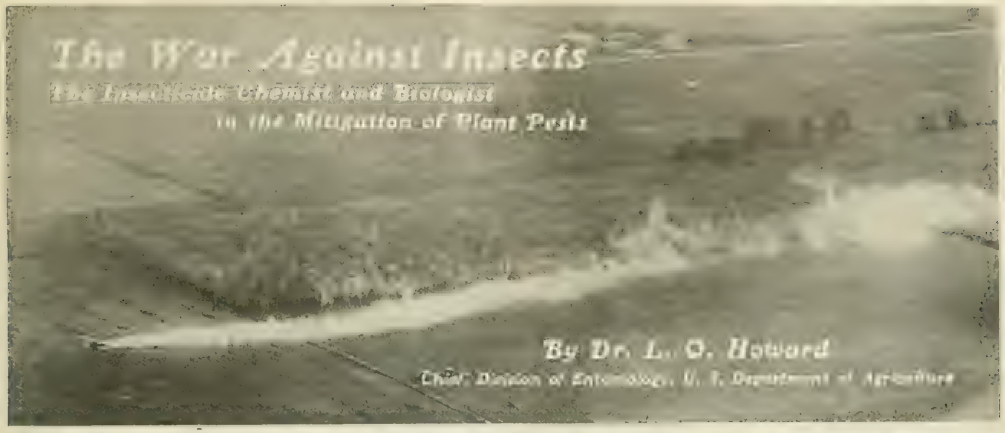
[illegible] succeeds H. R. Nelson, resigned, as general superintendent of the Warner Chemical Co., plant at Carteret, N. J.

The War Against Insects

The Insecticide Chemist and Biologist in the Mitigation of Plant Pests

By Dr. L. O. Howard

Chief, Division of Entomology, U. S. Department of Agriculture



The first experimental use in the United States of the aeroplane in the application of insecticides. Proposed by C. R. Neillie, City Entomologist, Cleveland, Ohio, and carried out by Lieut. John A. MacReady, Air Service Engineering School, Dayton Ohio, and J. S. Houston, Associate Entomologist, Ohio Agricultural Experiment Station, on the farm of Harry A. Carver, near Troy, Ohio.

THE war against insects has in fact become a world-wide movement which rapidly is making an impression in many ways. In the United States, for example, investigations in this field are for the time being receiving the largest government support. Every state has its corps of expert workers and investigators. The Federal government employs a force of four hundred trained men and equips and supports more than eighty field laboratories scattered over the whole country at especially advantageous centers for especial investigations. And there are teachers in the colleges and universities, especially the colleges of agriculture, who are training clever men and clever women in insect biology and morphology and in applied entomology both agricultural and medical.*

All this means that we are beginning to realize that insects are our most important rivals in nature and that we are beginning to develop our defense.

While it is true that we are *beginning* this development, it is equally true that we are only at the start. Looking at it in a broad way, we must go deeply into insect physiology and minute anatomy; we must study and secure a most perfect knowledge of all of the infinite varieties of individual development from the germ cell to the adult form; we must study all of the aspects of insect behavior and their responses to all sorts of stimuli—their tropisms of all kinds; we must study the tremendous complex of natural control, involving as it does a consideration of meteorology, climatology, botany, plant physiology, and all the operations of animal and vegetal parasitism as they affect the insecta. We must go down to great big fundamentals.

The Work of the Chemist in the Warfare Against Crop Pests

All this will involve the labors of an army of patient investigators and will occupy very many years—possibly all time to come. But the problem in many of its manifestations is a pressing and immediate one.

That is why we are using a chemical means of warfare, by spraying our crops with chemical compounds and fumigating our citrus orchards and mills and warehouses with other chemical compounds, and are developing mechanical means both for utilizing these chemical means and for indepedent action. There is much room for investigation here. We have only a few simple and effective insecticides. Among the inorganic compounds, we have the arsenates, the lime and sulphur sprays, and recently the fluorides have been coming in. Of the organic substances, we use such plant material as the poisons of hellebore and larkspur, pyrethrum and nicotine; and the cyanides and the petroleum emulsions are also very extensively used. No really synthetic organic substances have come into use. Here is a great field for future work.

Some of the after happenings of the war have been the use of the army flame-throwers against the swarms of locusts in the south of France, the experimental use against insects of certain of the war gases, and the use of the aeroplane in reconnoisance in the course of the pink bollworm work along the Rio Grande, in the location of beetle-damaged timber in the forests of the Northwest, and even in the insecticidal dusting of dense tree growth in Ohio. The chemists and the entomologists, working co-operatively, have many valuable discoveries yet to make, and they will surely come.

All this sort of work goes for immediate relief. Our studies of natural control follow next. It is fortunately true that there are thousands upon thousands of species of insects which live at the expense of those that are inimical to man and which destroy them in vast numbers; in fact, as a distinguished physicist in discussing this topic with me recently said, "If they would quit fighting among themselves, they would overwhelm the whole vertebrate series." This is in fact one of the most important elements in natural control and is being studied in its many phases by a small but earnest group of workers.

Biological Control

So far, while we have done some striking things in our efforts at biological control, by importing from one country into another the natural enemies of an injurious species which had itself been accidentally introduced, and while we have in some cases secured relief by variations in farm practise or in farm management based upon an intimate knowledge of the history of certain crop pests, we are only touching the border of the possibilities of natural control.

---

* From address of Dr. L. O. Howard, as retiring president of the American Association for the Advancement of Science, [illegible] at Toronto, Canada

For an understanding of these possibilities, we must await the prosecution of long studies, just as we must await years of progress of those other studies outlined in a previous paragraph. And all of these studies must be carried on by skilled biologists—thousands of them. At present most of the best men are working away in their laboratories practically heedless of the great and inviting lines of study at which I have hinted and heedless of the tremendous necessity for the most intense work by the very best minds on the problem of overcoming and controlling our strongest rivals on this planet.

The Warfare of Nature

Let us summarize. Few people realize the critical situation which exists at the present time. Men and nations have always struggled among themselves. War has seemed to be a necessity growing out of the ambition of the human race. It is too much, perhaps, to hope that the lesson which the world has recently learned in the years 1914 to 1918 will be strong enough to prevent the recurrence of international war; but, at all events, there is a war, not among human beings, but between all humanity and certain forces that are arrayed against it.

Man is the dominant type on this terrestrial body; he has overcome most opposing animate forces; he has subdued or turned to his own use nearly all kinds of living creatures. There still remain, however, the bacteria and protozoa that carry disease and the enormous forces of injurious insects which attack him from every point and which constitute today his greatest rivals in the control of nature. They threaten his life daily; they shorten his food supplies, both in his crops while they are growing and in such supplies after they are harvested and stored, in his meat animals, in his comfort, in his clothing, in his habitations, and in countless other ways. In many ways they are better fitted for existence on this earth than he is. They constitute a much older geological type, and it is a type which had persisted for countless years before he made his appearance, and this persistence has been due to characteristics which he does not possess and can not acquire—rapidity of multiplication, power of concealment, a defensive armor, and many other factors contribute to this persistence.

An Important Field of Research

With all this in view, it will be necessary for the human species to bring this great group of insects under control, and to do this will demand the services of skilled biologists—thousands of them. We have ignored these creatures to a certain extent on account of their small size, but their small size is one of the great elements of danger, is one of the great elements of success in existence and multiplication.

Let all the departments of biology in all of our universities and colleges consider this plain statement of the situation, and let them begin a concerted movement to train the men who are needed in this defensive and offensive campaign.

In closing, I can not refrain from quoting a remarkable paragraph from Maeterlinck:

> The insect does not belong to our world. The other animals, even the plants, in spite of their mute existence and the great secrets which they nourish, do not seem wholly strangers to us. In spite of all, we feel with them a certain sense of terrestrial fraternity. They surprise us, even make us marvel, but they fail to overthrow our basic concepts. The insect, on the other hand, brings with him something that does not seem to belong to the customs, the morale, the psychology of our globe. One would say that it comes from another planet, more monstrous, more energetic, more insensate, more atrocious, more infernal than ours. . . . It seizes upon life with an authority and a fecundity which nothing equals here below; we cannot grasp the idea that it is a thought of that Nature of which we flatter ourselves that we are the favorite children. . . . There is, without doubt, with this amazement and this incomprehension, and I know not what of instinctive and profound inquietude inspired by these creatures, so incomparably better armed, better equipped than ourselves, these compressions of energy and activity which are our most mysterious enemies, our rivals in these latter hours, and perhaps our successors.

Engineers' License Law in New York and Pennsylvania

The New York State Engineers' License Law passed May 14, 1920, and amended May 6, 1921, has become operative, with the announcement of a list of 171 successful applicants in a total of 241. A board of five engineering examiners representing the fields of electrical, mining, mechanical, chemical and civil engineering passes upon all applications. The board comprises: President, Albert H. Hooker, chemical engineering, Niagara Falls; vice-president, Major Percy E. Barbour, mining engineering, New York City; secretary, Henry G. Reist, electrical engineering, Schenectady; Virgil M. Palmer, mechanical engineering, Rochester; and Col. Walter G. Eliot, civil engineering, New York.

The following is a brief summary of the chief provisions of the law:

> No engineer unless licensed may legally practice professional engineering or land surveying after May 6, 1923, that is, two years after the date the law was amended.
>
> In a corporation, partnership, or joint stock association engaged in the practice of engineering the engineer in responsible charge of the work must be licensed. Subordinate engineers who report to such an engineer need not necessarily be licensed. It is to be hoped, however, that the prestige of a license will be such that all engineers who are eligible for license will apply for one.
>
> Some exemptions are allowed non-resident engineers practicing in New York State. No license is required for:
>
> 1. Offering to practice when having no established place of business in New York State.
> 2. Practicing when having no established place of business, provided such practice does not aggregate more than thirty days in one calendar year and provided such non-resident engineer is legally qualified for such professional service in his own state or country.
> 3. Practicing professional engineering or land surveying, provided application for license is pending, and fee has been paid. Such exemption to continue only for such reasonable time as is required for granting or denying of application.

Further exemptions are made for engineers practicing as pupils or under the direction of a licensed engineer, or practicing on work solely for the United States Government, and further, practicing solely as an employee of the state from the time act becomes effective until the expiration of the then existing term of office of such employee. The registration fee is $25 for a license either as a professional engineer or as a land surveyor, or $35 if the license be for both combined. The yearly renewal fee is one dollar if made prior to December 31, with a penalty of ten cents for each month's delay in paying renewal, accumulating a maximum of two dollars.

By June 1, 1922, all professional engineers or land surveyors practising in Pennsylvania must be registered, or exempted under certain provisions, according to the Act of the General Assembly, No. 422, approved May 25, 1921. All applications for a certificate of registration should be made as early as possible. The fees required by the Act are as follows: Professional engineer, $20; land surveyor, $20; professional engineer and land surveyor, $30.

Application blanks may be obtained from the State Board for Registration of Professional Engineers and of Land Surveyors, Harrisburg, Pa.

Canadian Institute of Chemistry

A Review of the Growth of the Idea. Its Organization, Functions and Future.

By Harold J. Roast, F.C.S., F.C.I.C.
Secretary, Canadian Institute of Chemistry

EVER since chemists took part in the development of Canada there has been a desire to have some means of forgathering and so to get the benefit of interchange of experience and the development of that spirit of camarardie that is a greater force than many may realize.

HAROLD J. ROAST, F.C.S., F.C.I.C.
Secretary, Canadian Institute of Chemistry

Origin of the Idea and Growth

The first definite attempt to secure co-operation between chemists along these lines was made by the late Dr. J. P. Girdwood, F.I.C., some thirteen years ago. Unfortunately nothing definite was accomplished, although the seed was sown. The next revival of the idea of organization was seen in the title of a paper on the program of the 1918 Annual Meeting of the Canadian Section of the Society of Chemical Industry, viz., "Association of Canadian Chemists," by Professor Matthew A. Parker of the University of Manitoba. At the close of this address a lively discussion took place as a result of which the chairman of the Canadian Section of the Society of Chemical Industry appointed a committee known as the Chemists' Organization Committee, with Professor Parker as Chairman, and of which the writer was elected Secretary.

After a year's steady work and many meetings held in Montreal, this committee drew up a preliminary report the main feature of which was the definition of the qualification for membership under the various grades, this being naturally the most contentious part of the suggested regulations. The preliminary report was made public and correspondence was invited and received by the committee. This preliminary report with some slight changes and additions was presented as a final report to the Convention of Chemists held in May, 1919, at Montreal, under the auspices of the Canadian Section of the Society of Chemical Industry, the local chairman of the society, Dean Goodwin of Kingston, being in the chair. After the most lively discussion ever heard in Canadian chemical circles, the report was adopted in a slightly modified form and a nucleus of members elected by acclamation. A meeting of this nucleus subsequently was arranged and the first Council elected and the machinery of the Canadian Institute of Chemistry was set in motion.

Organization

At the first annual meeting of the new Institute held in Toronto in May, 1920, the By-laws as drawn up by the Council were discussed and adopted. This annual meeting of the Institute also was held in conjunction with the general convention of chemists held under the joint auspices of the Society of Chemical Industry and the Canadian Institute of Chemistry. During 1920 and 1921 steps were taken to obtain a legal status for the Institute with the result that it was incorporated on August 15th, 1921, under Letters of Patent as a Dominion body. Its membership consists of both sexes and is scattered over the whole of Canada, some in England, the Argentine, New Zealand, and 13 in the United States.

It may be of interest to quote from the report of the Organization Committee, the essential features of which form part of the present Constitution and By-laws of the Institute, to wit:

The Committee is of the opinion that:—

The organization of Canadian chemists is best undertaken by an entirely new and separate organization rather than by endeavoring to carry out such organization under the auspices of any existing society.

The name Canadian Institute of Chemistry is the most suitable name for such an organization.

The nucleus of the proposed association be a body of original members.

The membership consists of two classes, viz., Fellows and Associates of either sex, the former having the right to use the letters F. C. I. C. and the latter having the right to use the letters A. C. I. C.

The following be the requirements for Fellows:—

A. One who shall be of the age of twenty-five or over being a graduate of a recognized university having a four-year course in chemistry or science and who can satisfy the Council that chemistry pure or applied has been his major subject, and who has been actively engaged in the pursuit of chemistry in a responsible capacity for two additional years.

B. One who shall of the age of twenty-five or over, being a graduate of a recognized university giving only a three-year course in chemistry or science, who can satisfy the Council that chemistry pure or applied has been his major subject, and who has taken another year's training at a university and has had in addition two years' experience in chemistry at a laboratory approved by the Council or under the direction of a Fellow of the Institute.

If the additional year at the university is not taken then three years' training in a responsible capacity in a laboratory approved by the Council.

C. Those who do not qualify under "A" or "B," being of the age of twenty-five or over, shall have held a position of responsibility in pure or applied chemistry for not less than five years, and [illegible] the Council. The candidate shall be examined on the theory and practice of chemistry with special reference to that branch of chemistry in which he has been engaged. This examination may be waived at the discretion of the Council if the candidate was engaged in chemistry at the date of the inauguration of the association and has held a position of professional responsibility for not less than eight years.

The following be the requirements for Associates:—

Persons of any age who otherwise would be eligible for membership as Fellows under provision A, B or C, the requirements under A and B regarding the practice of chemistry in a responsible capacity for two years being waived.

An Associate upon reaching the age of 25 may become a Fellow provided he is recommended by three Fellows and has been engaged for at least two years in the practice of chemistry pure or applied.

All applications for either Fellowship or Associateship must be accompanied by references from at least three Fellows of the Institute.

Each candidate shall submit evidence to the Board to satisfy the said Board that the candidate has a good general education.

The entrance fee for Fellows be $10.00 in addition to the annual fee of $10.00 and that the fees for Associates be one half the above. All fees being payable in advance.

The objects of the association be:—

I. To raise the profession of chemistry to its proper position amongst the other learned professions so that it may attract a larger proportion of the best intellects and thereby secure a supply of trained chemists adequate to the growing industrial needs of the country.

II. To form an organization immediately available for consultation by the government.

III. To protect the public by gathering together a body of chemists who may be consulted with confidence.

IV. To look after the professional well being of chemists by

(1) Having a registration bureau for chemists.

(2) Having social centres for chemists.

(3) Maintaining an employment bureau for chemists.

(4) Having centres for the interchange of scientific experience by both papers and lectures.

(5) Maintaining a clearing house of available chemical knowledge, including a library and suitable register that would enable the central bureau to put one chemist in touch with that other chemist who might be able to assist him in his particular problems (leaving to the parties interested to arrange details as to recompense or otherwise).

(E) To secure such government recognition as may from time to time be deemed advisable.

(F) To maintain a professional association for professional men."

Functions

Although provision seemed to have been made for most eventualities it was surprising how many details arose that needed careful investigation to avoid ambiguity, and how much patience was required to carry the matter through to the satisfaction of all. Need was found for the appointment of committees having regard to the various objects of the Institute.

Incorporation, as already stated, was sought and obtained under Federal Charter because it was felt that the Institute should represent the chemists of Canada as a whole, and that the professional needs of the chemist in British Columbia would not be greatly different from those of his brother in Quebec or New Brunswick.

Prior to the establishment of the Canadian Institute of Chemistry there was no available list of the chemists of Canada and their specialties nor was there any organization of the profession for either social or scientific benefit, with the result that as soon as the chemist left his Alma Mater he was lost track of and became engulfed in the general turmoil of commerce. The individual chemist had nobody that he could appeal to, feeling that his case would receive competent consideration. Particularly was this so in the matter of remuneration both in the government and out of it. Since the formation of the Institute work has been taken in hand with the view of compiling a "Chemical Who's Who" in Canada, thereby providing a reference book of chemists and their specialties available to such bodies as the Government, Boards of Trade and commercial concerns.

With the existence of the Institute the 'Varsity graduate is able to enter into the closer membership of his profession and is able to get in touch with all the help and incentive that such an organised profession can supply. In regard to remuneration, a special committee is working to the end that a definite minimum salary may be decided upon by the Institute as a body competent to judge, as a fair one for the various classes of chemists and chemical work.

Independent Existence

Now all these points are of a purely professional nature and can be most satisfactorily dealt with by an association of purely professional men. This fact was the underlying reason for the recommendation that the new body should not be part of any other existing Canadian association of which the membership was largely diluted with non-professional members. Further it was felt that what was needed was a body, membership in which meant *per se* that the one belonging had qualified before a board competent to judge.

In the universities, graduates with degrees of B.Sc, or B.A.Sc may be engineers, chemists or physicists, and consequently the profession of chemistry is not consolidated by the conferring of such degrees. There is therefore still need for an elective body that shall consolidate the chemists of the country into a truly professional body having its own code of ethics, its own craft standards, and through which its members can act as a unit in matters of general and vital interest.

The proof of the reasonableness of such a conception of organization may be found in the fact that the Canadian Institute of Chemistry, although only in its second year, already numbers over two hundred qualified professional members in a country where the total possible membership is probably not more than four hundred. Further an endeavor has been made to provide for the future by means of Student Membership in which class, only started last October, there are over forty members who are intensely interested in forming part of that profession for which they are qualifying.

One thing should be borne in mind and that is that the Canadian Institute of Chemistry grew out of the Society of Chemical Industry, and also that it had from the beginning the good wishes of the similar Institute of Chemistry in Great Britain, showing that there was no conflict between them, and acknowledging that the Canadian Institute of Chemistry filled a real want in the professional life of Canada.

It also is a fact that those most active in the Canadian Institute of Chemistry are also very active in the other organizations having the welfare of chemistry, if not chemists, as their watchword thus providing a further evidence that the establishment of the new Institute has in no way injured existing organizations.

In time to come need may be found for provincial associations, but in any case there always must be an advantage to the profession to have one Dominion-wide organization to which all professional chemists may belong and whose interests will be Dominion-wide, and further which will be ready to act internationally for the good of the profession of chemistry. Anything in the foregoing must be taken as the opinion of the writer personally and not as from the Canadian Institute of Chemistry of which he is Secretary.

(To Be Continued)

The German government has notified the State Department that Alanson B. Houghton, Corning, New York, is acceptable to that country as American ambassador. Mr. Houghton is an officer of the Corning Glass Works and the representative from the 37th New York Congressional district. No opposition to his appointment is expected in the Senate.

Products of Low Temperature Distillation of Coal

By Dr. Walter Runge

Vice-President and General Manager, The Bregeat Corporation of America.

THE development of the coal tar industry and the processes involved in the production of coal tar, have made long strides forward during the last four or five decades. It is not much over fifty years ago since the first by-product coke ovens were brought to this country and after many trials, tribulations and some failures they have reached a high degree of perfection.

While there are other forms of tar such as coal gas, water gas, blast furnace and wood tar, still the one most produced and the largest individual raw material for the tar oils used in coal tar disinfectants, is the tar from the by-product coke ovens. This material is and has been for a good many years the base for a large number of organic compounds, wood preservatives and disinfectants. It is therefore natural, and rightly so, that it and the simple products derived from it, should be looked upon with a great deal of favor.

We desire to discuss a new type of tar made by a new industrial infant; not one young in years, for it was born many years ago, but rather one that has been slow to mature because it has been poorly nourished and because of the many obstacles that have been placed in its path.*

This infant, or process, has met the same opposition that the by-product coke oven encountered, when it was first introduced, from the advocates of the old beehive process. It was something new and was therefore not to be tolerated because the old was good enough. Because of this and because of the loss contingent upon the scrapping of the investments in the beehive ovens, it has been only during the past few years that the production of by-product coke exceeded the quantity of coke produced by the beehive ovens. It took over fifty years for this transition to take place, and it is to be hoped that recognition of this new industry may be accomplished in a much shorter interval.

Low Temperature Carbonization of Coal

In the development of low temperature carbonization many methods, processes and different types of apparatus have been tried with varying degrees of success, but now after many years the goal has been attained.

Low temperature carbonization differs from high temperature essentially only in the degree of heat to which the coal is subjected during distillation. In the by-product oven the temperature reaches 2,000-2,200° F.; while in low temperature the heats are maintained between 900 and 950° F. Because of this difference, the nature of the tar and that of the tar distillates differ.

The Smith Process

The Smith process of low temperature distillation is an American process and the first of its kind to be built on a commercial basis either in this country or elsewhere. The Carbocal process, for such it is called, is in reality a combination of high and low temperature distillation of coal, but inasmuch as the coal is first treated at low temperature, and this is the most important step in the process, it is placed in the latter class.

This process is now being used by the Clinchfield Carbocoal Corporation at the plant it operates at South Clinchfield, Virginia. The plant has a capacity of treating 500 tons of coal per day and consists of 24 primary or low temperature ovens and 10 secondary or high temperature retorts. The coal after it has been ground to pass a ⅜-inch grate is introduced into a heart-shaped retort approximately 18 feet long and 7 feet in width at its widest point. The oven is provided with two paddle shafts running its entire length and attached thereto are numerous paddles. The principal feature of these ovens is the continuity of operation. The coal is introduced in a continuous stream and is picked up by the paddles which agitate it and at the same time push it forward toward the discharge end containing a properly sealed discharge box. Here the coke, or more properly the semi-coke, is discharged upon a conveyor which removes it to the briquetting house, where the next step in the operation is performed.

The vapors and gas that are liberated during the distillation are removed from the oven by means of an exhauster or fan. These are drawn through the usual condensers, tar extractors and scrubbers, and the tar, ammonia and other condensable vapors are removed while the non-condensable gas is returned to be used as fuel. The semi-coke after it is removed from the ovens is next crushed, mixed with pitch obtained from the distillation of the tar, and briquetted. These briquets are then carbonized or distilled in the secondary or high temperature retorts. These are of the inclined type and are operated at a temperature of 1800°F. This part of the process is intermittent, the briquets being charged into the retorts, carbonized for six to eight hours and then discharged. An additional quantity of tar, gas and ammoniacal liquor is obtained and these are treated in the manner just described.

Future of Low Temperature Carbonization

The development and enlargement of the industry depends upon the success that the fuel encounters, as in the last analysis, it is the production of a satisfactory fuel that the process has as its main object. In this connection it is only necessary to say that a campaign, starting last spring and taking only six months, in which at no time were more than five men engaged, sold the entire production of the Clinchfield plant until the spring of 1922.

The process is not limited to the use of certain coals such as confines the successful operation of coke ovens, for it handles equally well coals of both the coking and non-coking type. This, of course, gives it a big advantage over the by-product oven, and the types of coal that may be used and the points at which future plants may be located are much more numerous.

Comparison of By-Products of High and Low Temperature Distillation

A comparison of the by-product yields obtained from by-product coke ovens and from the Smith process, per ton of coal carbonized, is given as follows:

	By-Product Ovens	Smith Process
Gas	11,000-12,000 cu. ft.	9,000-10,000 cu. ft.
Ammonia sulphate	[illegible]	20 lbs.
Crude light oil ...	[illegible]	[illegible]
Tar	[illegible]	[illegible]

It will be noted that the most essential difference in the by-product yields are those of the gas and the tar.

---

* Presented at the annual meeting of the Insecticide and Disinfectant Manufacturers' Association, New York City, [illegible]

The by-product ovens produce a greater volume of gas per ton of coal carbonized, while the Smith process produces a much larger quantity of tar. The figure of 24-30 gallons represents the yields from different types of coal; the coal higher in volatile matter giving a higher tar yield. (This does not include the lignites). At present at the Clinchfield plant, using a 35 per cent volatile coal a yield of 27 gallons per ton of coal is being obtained, but it is probable that this will be increased as various refinements are made in the process.

To many tar is tar—a black sticky liquid with a disagreeable odor—a substance that is to be avoided—but to others it presents many interesting and puzzling problems. Its origin, or method of production, governs its physical as well as its chemical properties. Compare for instance the high with the low-temperature tar. The former has a specific gravity running usually from 1.15 to 1.20, the latter a gravity of 1.00 to 1.10; the former a free carbon content of 8-15%, the latter one of 4-6%; the former a pitch content of 65-70%, the latter 45-50%.

Distillation Products of High Temperature Tar

The oils derived by distillation differentiate even more than the tars from which they are obtained. The light oil from high temperature tar, representing the cut between 0 and 170°C. consists mainly of aromatic hydro-carbons and is one source for benzol, toluene, solvent naptha and heavy naptha; the next cut, from 170-230° is the carbolic or middle oil containing a larger portion of tar acids and napthalene; the third or creosote cut taken from 230° to about 300°C. represents the material used as wood preservatives, and the last fraction from 300°C. up bears the name of anthracene oil which identifies it.

To return for a moment to the second or middle oil cut. This fraction after it is condensed is allowed to settle and cool and in a short time becomes almost solid due to the separation of naphthalene. An analysis of the oil as it comes from the still will show an average tar acid content of 8-10, sometimes as high as 15 per cent. Artificial cooling is a good adjunct in the removal of the naphthalene and it is a process to be recommended as the oil dependent upon atmospheric cooling will not be of the so-called "naphthalene free" type, will not run uniform in composition and will probably, when least desired, turn partly if not entirely solid.

After the middle cut has been settled for a sufficient length of time it is removed mechanically from the oil; usually by means of a whizzer or centrifuge. The oil which is thus obtained is sometimes marketed as whizzed oil and from demand made for it, would appear to be suitable for many purposes. It not only finds an outlet in the manufacture of disinfectants, but is being used by some copper companies for flotation purposes. It runs as high as 30% in tar acids, has a gravity of 1.03 and a distillation range running from 180 to 310°C. Unfortunately the production of this oil is not large and the sale of it is curtailed as it is often used as the source of carbolic and cresylic acids.

Distillation Products of Low Temperature Tar

The light oil from low temperature tar may be passed by as it is of little importance except that it contains as high as 10 per cent of tar acids.

While the usual method of refining the high temperature tars is followed in the distillation of low temperature tar and the cuts made are usually within the same general ranges, the oils bear little resemblance to the high temperature products.

Thus while the middle oil from high temperature tar contains 10 per cent of tar acids, the same from low temperature tar contains well over 30 per cent and when obtained from certain coals, as high as 45 per cent. It does not have to be fortified with cresylic acid before it is suitable for disinfectant purposes, but, if anything, must have its acid content reduced by means of a neutral oil. While this may not appear as an advantage to some, it is decidedly so, when considered in a broad aspect. The source of supply of the fortifying acid is extremely limited, being confined principally to European countries. The origin of this oil being so remote from the points of consumption in this country, its delivery is often accompanied by unusual delays contingent upon trans-Atlantic transportation. On the other hand, the supply of neutral oil is large and it may be obtained in many localities. Further the supply of acid is subject to rapid changes in unit price, consequently few are willing to store much over their immediate needs or requirements.

Probably the greatest asset of low temperature oil is its freedom from naphthalene and this should appeal to manufacturers who are desirous of having their products reach their destinations and the ultimate consumer in an absolutely liquid condition. The oil is not treated to remove this objectionable compound, but its freedom from it is an inherent property. The low temperature at which the coal is distilled prevents or inhibits its formation, in the same manner that it assists in the formation of large quantities of acid bodies.

The phenol coefficients of the low temperature oils are high and vary with the temperature at which the various cuts are made. These coefficients were determined by the Hy-Lab-Method and show the following:

170-230° C. Fraction	Coefficient 5-6
230-270° C. Fraction	Coefficient 6-7
270-300° C. Fraction	Coefficient 2.5-3.5

While the coefficients of these oils may not be considered high when compared with other oils, it must be remembered that they represent straight run distillates, i. e., distillates obtained from the tar itself by one distillation, that they are not subjected to subsequent distillation and are not fortified by the addition of high boiling acids.

A much discussed question in connection with disinfectant oils is one of gravity. In general it may be said that, except in cases where special cuts are made, that the gravity of the low temperature oils suitable for disinfectant purposes will be less than one. Whether this is a disadvantage must of course be left to the manufacturer of the disinfectant and dip. To me it seems that psychology plays the important part, and that because the oil is more limpid than the product that it has been the custom to receive, it is not desirable. In fact, it has been stated that the oil was not a coal tar product because it had a gravity of less than unity and because it was limpid. But even granting that both the viscosity and gravity of the oil are low, the question is of no importance; because the dips made from these oils are completely soluble.

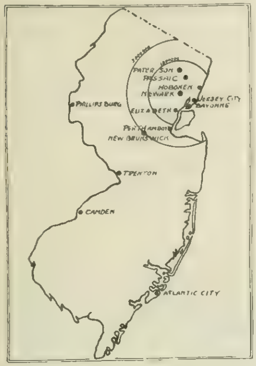
The quantity of low temperature oil containing at least 25 per cent of tar acids that will be produced at Clinchfield during 1922 has been estimated at well over a million gallons. This is the first plant of its kind in the country and within a few years, as the industry grows, the production should be many times this amount.

So far the oil has been used by many manufacturers of disinfectants, but it is not alone in this direction that it finds an outlet, for successful use of it has been made for flotation purposes, and the results so far obtained from the studies that are being made as to its suitability for wood preserving are highly encouraging.

College of Engineering of the Newark Technical School

Description of a Factor of Increasing Importance to the Industries of Northern New Jersey and an Encouragement to Technical Institutions to Make More Efficient Their Service to Local Industry. Natural Selection Applied by the Institution to Young Men Who Seek Technical Education While They Work.

The glory and the successes of education in the United States are due to its freedom, to its unevenness, to its reflection of the needs and ambitions and capacities of local communities, and to its being kept in close and constant touch with the people themselves.—Nicholas Murray Butler.



THE educational service of the Newark Technical School, with that of its affiliated College of Engineering, to one of the most prominent industrial regions of the country, not only directs merited attention to the school itself, but provides a good example of the principle that institutions of technical training are becoming more and more community institutions, a process measured by their co-operation with industry in the training of its adminstrative recruits.

A school's relations with the industrial field for work in which it trains men are reflected directly by the rapidity of their absorption and by the measure of their success. Personnel research has disclosed the fact that native characteristics are more determinative of a young technical man's success than any acquired characteristics represented by his education. The importance of the former in the acquirement of the latter characteristics can be recognized and used most effectively in the selection of men worthy of intensive training for technical professional work in institutions dedicated to community service. With such a system and in such an environment as that displayed by the functions and location of the Newark Technical School, there is possible that minimum of waste in the training of administrative men for production that the conditions of the time demand.

The growth of this institution in thirty-five years from one providing solely vocational training to that of collegiate character, awarding degrees in mechanical, electrical and chemical engineering, represents on the one hand the alertness of its management and on the other a measure of co-operation of New Jersey's industries which, if exerted consistently, would make the College of Engineering of the New Technical School a potent factor in the industrial educational system of the state and in the progress of its manufacturing enterprise. A description of the growth, service and possibilities of an institution of this kind is valuable to every industrialist and technical educator who aim to make the educational system of their own communities more responsive to the needs of industry and more helpful to its young men.

Origin and Administration

The Newark Technical School was established in 1883 and shares the distinction with a similar institution at Toledo, Ohio, of being the first two schools of its kind in America; in the interim technical education as we know it today has developed. It is a state and city institution governed by the Board of Trustees of Schools for Industrial Education, with the Governor president ex-officio, and the Mayor a member of the Board whose membership comprises a representative group of business and professional men of northern New Jersey, and includes Peter Campbell, Nairn Linoleum Co., Kearny; Herbert P. Gleason, Johnston & Murphy Shoe Co., Newark; Frederick L. Eberhardt, Gould & Eberhardt Co., Irvington; John A. Furman, The Celluloid Co., Newark; Halsey M. Larter, Larter & Sons, manufacturing jewelers, Newark; Wm. L. Morgan, Counsellor-at-Law, Newark, and Samuel E. Robertson, M. D., Newark.

Originally concerned with vocational education, with the growth of specialization and the increasing assump-

Academic Building, Newark Technical School

Laboratory Building, Newark Technical School tion of this type of instruction by local boards of education, the school's work gradually lost its vocational character in the greater prominence of technical instruction, until the latter assumed a distinctively professional character ranking in its College of Engineering with the most efficient of its kind. Allan R. Cullimore (S. B. in Civil Engineering), Mass. Institute of Technology, is director of the Newark Technical School and Dean of the College of Engineering whose faculty comprises men from Columbia, Syracuse, Brown, Cornell, Johns Hopkins, Vienna, Missouri, Rose Polytechnic, Bates; Worcester Polytechnic, New York and Massachusetts Institute of Technology.

ALLAN R. CULLIMORE, '07, M.I.T.
Director, Newark Technical School, and Dean, College of Engineering

Purpose and Ideal

The purpose of the school is to furnish to the industries of New Jersey, particularly of the northern section where for their variety and size no similar area in the world presents their counterpart, men trained for administrative work in *production* rather than for work in *research* in mechanical, chemical or electrical lines.

Its ideal is the establishment of a system of education rather than the creation of the physical habiliments of an institution, for the realization of which the plan of the school and the intimacy of its contact with industry readily are adapted.

Methods

The Newark Technical School conducts day and evening sessions. The evening sessions are attended by 1,100 young men at work during the day in various positions in industry. The instructional period is long and attendance is required five evenings of the week. Only the exceptional men, therefore, succeed in graduating in this course. The subjects of the course are essentially descriptive with no time devoted to instruction in manipulative or industrial procedure, reliance being had upon prior vocational training, apprenticeship instruction in plant, or daily factory experience for the inculcation of applicative methods in the day's work.

The College of Engineering is the logical extension of the activities of the Technical School where instruction in applied science in mechanical, electrical and chemical engineering is pursued by students who graduate either from local high schools or from the courses of the Newark Technical School.

Scrutiny of the young men pursuing engineering courses and who graduate from high schools discloses a large percentage temperamentally unfitted for an engineering career, while with those entering from the evening sessions of the Technical School it is found that a much greater percentage, having been tried out in the fire of industrial experience, display certain indices of success in engineering work which later observation abundantly confirms.

The evening school attempts to select the young men who illustrate the earmarks of material efficiency and to stimulate them not only by the academic instruction provided by the school, but to a considerable degree to finance the college training of youth of exceptional promise by the granting of scholarships in the College of Engineering. Young men who while acquiring their professional education have maintained their contact with the industry for which they are preparing themselves, make the best advanced students. Accordingly the staff of the Newark Technical School and of its College of Engineering believe that a system of technical education wherein the student body is selectively chosen will furnish results which for quality can be obtained in no other way.

The College of Engineering of the Newark Technical School was founded four years ago when the state gave the school the right to grant collegiate degrees. The work immediately was organized upon the sound basis following very generally the scholastic requirements of the best technical schools, but endeavoring to incorporate in the plan the scheme of co-operative education which has been so successful at the University of Cincinnati. According to the plan adopted by the College of Engineering, a young man takes up his first two years of academic work in exactly the same manner as he would do in any engineering college, with the exception that the length of the term exceeds that in the average engineering school and the number of hours' work is considerably in excess of that usually required. During his first two summers the student is required to engage in some industrial work along the line of his chosen profession. At the beginning of the junior year alternate two-week periods are spent in shop and in the college, this scheme holding throughout the last two years.

Cooperation With Industry

The school has, it is believed, entirely satisfactory co-operative arrangements with the Charles Cooper Chemical Co., Crocker-Wheeler Co., Gould & Eberhardt Co., Nairn Linoleum Works, Weston Electrical Instrument Co. and Mechanical Efficiency Co.

The plan for co-operative work as used in the College is very advantageous in that it insures to the co-operating concerns not only men of high grade and tested ability and integrity, but who have had training along the line which they aim to follow in the industry. As an example it might be stated that in the first class of co-operating students there were 12 men, those left from an original entering class of 38. They were men who have been tried thoroughly not only by the academic standards of the school, but by their two summers' work in industry.

It will be of interest to point out some of the principle features of the scheme of industrial co-operation in the work of instruction. In the first place the man who goes into industry for co-operating periods is entirely under the control of the industrial plant management. The school has nothing whatever to say about the hours he works, or the pay, if any, which he receives. The same general rules governing the other employees govern the work of these men and the school does not attempt to exercise any supervision over the individual students while engaged in the plant. The relations between the industry and school are handled by a man called a "co-ordinator" who has entire responsibility to the school for properly carrying on instructional work in the industry. He receives at intervals reports from the foreman or others directly in charge of the student. He visits the plants and gives advise when necessary, and is the go-between in so far as the school and the industry are concerned.

The professors in the school have no connection with the industrial plant; their function is to teach as effectively as possible the courses under their direct supervision. These courses are outlined with the cooperative idea primarily in mind. There is, however, a distinct line of demarcation between the instructional work of the school and that of its co-operator. These two aspects of the school's work are brought together by a third department headed by the director of the school whose function is to correlate the work of instruction by the school with that of the industry. This department receives through the co-ordinator information concerning the status of the work in industry in a very detailed form. Round table discussions are arranged in which the students themselves, the director, the co-ordinator and one or more professors take part. These talks while rather informal in presentation are carefully prepared on the part of the teaching force and serve to bring out in a very direct way lines of correlation between academic and practical work.

It should be clearly understood that this school has two separate and distinct although closely correlated functions. One is to give a regular four-year course at night in mechanical, electrical and chemical engineering leading to the title of Associate Engineer; the other is to give courses of strictly collegiate grade during the day. The school believes that the co-operative factor in the training of engineers is an extremely important one. The basis of the day work, as well as of the night work, is that close, continuous and supervised contact with industry during the time of a man's engineering education is of the very greatest importance. In the night technical courses this contact is furnished of necessity by the young man's work during the day. The aim of these courses being to develop men, who already possess the vocational back-ground of skill, into men who may, by a proper study of the technical side of the work, develop into production executives. During the thirty-five years of its existence, the school has functioned very successfully in this respect. A census of the industries of Newark would reveal that many of the production executives are Newark Technical School graduates.

The Region Served

The location of the Newark Technical School would

STAFF OF THE COLLEGE OF ENGINEERING AND EVENING SCHOOL OF THE NEWARK TECHNICAL SCHOOL

Allan R. Cullimore, Director [illegible] *(Chemistry)* [illegible] *Design), successor Wm. Nutschel.* [illegible] *(Mathematics)* [illegible] *(Modern Languages). J. J. Arnao, Jr. (Spanish).* [illegible] *Chemistry).* [illegible] **A. de G. Hentzler (Spanish). C. E. Dail* [illegible] *J. H.* [illegible] *Arnold, V. A. Arnold, *Wm. Fielard,* [illegible] *B. Kistl*[illegible] ***Wier, H. W. Heilman (Mathematics), J. S. Clark, R. E. Guillo***[illegible] *(Automotive* [illegible] *(English). L. D. Kelon, H. H. Holland* [illegible] *C. W.* [illegible] *(Physics). J. Monaghan (Plumbing).* [illegible] ***(Electricity). R. G. Merz, B. P. Jenki***[illegible] *Additions to staff not included in photo* [illegible] *F. A. Board* [illegible] ***P. Vreeland** (Arch. Drawing); Thos. F. Norwell* [illegible] *H. Adams (Electricity)* [illegible] ***(Textiles and Drawings).***

---

*Not at present a member of the staff

seem to be the best in the United States for the education of the right type of an engineering or industrial executive. It is doubtful if there is anywhere in the world a greater diversification of industry than exists in the southeastern part of New York and the northern part of New Jersey. What is true in regard to the character of industry, is also true as regards the population, and any school which sets for itself a task so definite, could hardly find a better situation in which to work out its destiny.

A glance at the map of New Jersey will show within a radius of 15 miles of Newark that there is a population of about 1,500,000 and within a radius of 25 miles a population of 2,000,000 or more. If this radius be extended to 50 miles, which is a fair commuting distance, the population is upward of 6,000,000. In all this territory there is not one school of engineering grade operating upon the co-operative basis.

Chemical Engineering Instruction

Proximity to raw materials, fuel and markets and accessibility unsurpassed because of rail and water transport facilities, contribute to make New Jersey the foremost chemical manufacturing state. Unequalled opportunities, therefore, exist for co-operation between chemical industry and the institution in chemical engineering education.

The war has been a powerful factor in demonstrating the need for closer co-operation between the institution and industry in training men for technical professional careers. The institution can no longer say to the industry, "We do not need your advice and help in preparing our students;" neither can the industry say to the institution, "We do not need your theory in training our workmen." The industrialist needs both theory and practical experience during his course of educational training.

It is interesting to note the different statements in response to questionnaires sent out to a number of industrial concerns. Some of the defects in training noted by the employers of chemists are as follows:

> The young graduate cannot evaluate measurements and lacks accuracy where it is required and tries to be too accurate where it is not required.
>
> Lacks ability to represent experimental data graphically.
>
> There is great carelessness in handling apparatus, especially sensitive instruments.
>
> Notes are often inadequate, insufficient and unenlightening—sometimes even untrustworthy.
>
> The young graduate is content to get only the data asked for and seldom goes beyond that point.
>
> His English is defective.
>
> There is a decided lack of independence and initiative. The young graduate requires too much assistance.
>
> The young graduate does not do sufficient reading on the side.
>
> He does not know how to apply practically what he has learned during his course.
>
> He has very little idea that the business world is concerned with profits, and seems to be utterly lacking in a knowledge and realization of values when he enters the industrial plant.
>
> Chemistry is to the student the means of getting a job rather than a real part of him, or an essential part of a commercial process.

It is to obviate these objections of industry that the College of Engineering of the Newark Technical School aims to coordinate the educational institution and industrial plant in such manner as to give the student the proper training during his college engineering course. Accordingly, the instruction in chemical engineering is designed to give a thorough grounding in the fundamental principles and theories of engineering and chemistry, together with as much factory experience as possible.

Considerable opportunity is given the individual student to select work along those particular lines which he intends to follow after graduation. In this way, those desiring a course in chemistry as distinct from chemical engineering are accommodated. Such training is adapted to those wishing to become teachers of chemistry or analysts, and the plan provides for close contact with the industry during the entire course.

Chemical Staff

Instruction in chemistry in the College of Engineering is provided by David K. Howard, B. S. (Alfred University), A. M. in Chemical Engineering (Columbia), in general and industrial chemistry and qualitative analysis; by V. T. Stewart, Ph. B., B. S. in Chemical Engineering (M. I. T.) in organic and physical chemistry, quantitative analysis and metallurgy and by Frederick D. Crane, A. B., A. M., Ph. D. (Johns Hopkins) in organic chemistry. Additional instructors in chemistry in the Newark Technical School comprise C. E. Dull, J. C. Bender and A. Craig in general chemistry and S. D. Perlman and G. H. Johnson in textiles and dyestuffs.

Adjustment in the Packing Industry

The annual report of J. Ogden Armour, president, Armour & Co., for the fiscal year ended October 29, 1921, is a reflection of business conditions that have prevailed in this important department of chemically controlled enterprise. Relative to a total turn-over in 1920 of $900,000,000 that netted profits of $5.319,975, 1921 showed on a gross business of $600,000,000 a loss of $31,709.817. In his report, Mr. Armour says:

"The year just passed was the most disastrous in our business history, as well as in the packing industry in general. A business such as ours must carry many millions of pounds of products in process of cure. Price declines, therefore, mean losses not only in sales but in inventory values as well. Extent of these losses can be visualized in price fluctuation of live hogs, which fell from a 14-cent level at the beginning of the year to a 7-cent level at the end. Our principal losses for the year were incurred in fields of enterprise other than the meat lines.

"In normal times distribution of risks through further processing of by-products, cotton oil products, etc., is a safeguard, but last year it increased our losses because after-war liquidation was more in most of these lines of business, than in our main business. Armour Fertilizer Works, the third largest in the industry, suffered in common with the whole fertilizer industry and lost $8.250.000. Canned fruit and vegetable business lost heavily. Our agreement with the Government compelled us to take not merely market losses on these products, but additional losses from forced sales to liquidate within prescribed limits. Big losses resulted from the situation in the tanning business.

"With losses completely written off and with inventory at current market values, there is every reason for looking forward to better times. Our raw material and finished product prices are at prewar levels, and further liquidation is unwarranted and hardly probable. Operating costs have been adjusted toward normal levels, while wages, constituting biggest factor in this field, have been reduced approximately 25 per cent. I firmly believe next annual statement will show satisfactory results."

Application of New Knowledge to Industry

Forest Products Laboratory is Hampered in This Service by Lack of Funds

THE Forest Products Laboratory, Madison, Wisc., of the Forest Service of the U. S. Bureau of Agriculture has accumulated in its eleven years of research a wealth of fundamental knowledge of immense value to the wood-using and consuming industries, and each year it is becoming of greater importance to devise ways and means whereby this information can be put into effective use. Personal interviews, correspondence, government publications, articles for trade and scientific journals, news and technical notes, instructional courses to trade representatives, and special investigations in direct co-operation with industries are all used by the laboratory with more or less success to accomplish this object.

From one-fifth to one-sixth of the total amount appropriated annually has been used in these ways. But the degree of accomplishment is slight compared with the progress made in the research work or compared with tremendous possibilities for economic savings if all of the results were broadly and intelligently applied in the industries. This situation will continue unless definitely recognized as a problem to be handled, and ways means developed for its effective solution. Within a reasonable period of time, it is believed that as much if not more funds should be annually expended by the laboratory on this phase of the work as on the fundamental research.

A limited number of very specific dissemination activities would involve an expenditure for the coming year of at least $100,000. It is felt that an appropriation for this amount would be well worth while as a starting point towards the development of a more progressive policy in the dissemination and application of results of research.

Some of the more conspicuous opportunities which should be pushed forward immediately, which offer wide fields for successful development and which require dissemination by direct and personal contact are the (1) introduction of preservative treatment of mine timbers, (2) promotion of scientific methods in the kiln-drying of lumber, (3) standardization of building codes and (4) reduction of wood pulp decay, requiring a minimum of $40,000.

Dissemination of new knowledge, obtained by research, by means of intensive instructional courses would require at least $20,000.

Commercial Demonstration

Many problems under investigation in the forest products field, after reaching a certain successful stage, in laboratory research, can be carried no further until tried out, demonstrated, and more or less modified on an actual commercial scale. This means the development of co-operative relationship with some commercial concern that is willing to permit the use of its equipment for the trial. The idea may not prove successful on a commercial scale and may cost the company considerable money as a result of the tying up of equipment, etc.

Experience has shown it to be difficult to arrange satisfactory commercial co-operation of this nature if the co-operator is asked to bear all of the expenses, and the progress of the laboratory has been hampered insofar as funds have not been available for such application. A minimum fund of $20,000 should be available for such use during the coming fiscal year. A number of projects already at the stage for a commercial demonstration, the successful development of all of which would require considerably more than $20,000, are as follows:

De-inking of Old Newspapers

A process has been developed using bentonite, an American clay, described in CHEMICAL AGE in the December, 1921, issue at page 493, to de-ink old newspapers and make pulp for reuse in the manufacture of newsprint. The complete utilization of all waste newspapers would amount to over 45 per cent. of the present tonnage of newsprint produced in the United States, which would mean a theoretical possible consumption of spruce and balsam for this purpose amounting to 850 000 cords per annum.

This process should be demonstrated and applied in several of our large cities. A large paper mill is under way in Chicago and another one in Philadelphia. A company in Brooklyn is operating on material shipped from such distances as Quebec and Ontario. These plants are admirably located to make economic use of the waste in their home cities. Commercial co-operative assistance in such cases would mean not only carrying out a demonstration but actually seeing the installation through to satisfactory commercial operation.

Bleaching of Southern Pine for Pulp

The laboratory has developed methods of pulping and bleaching southern pine pulp for book and magazine paper. This utilization project should be carried to a commercial conclusion in co-operation with the proper paper companies.

Improved Methods of Wood Distillation

On a laboratory scale, methods have been developed for very materially increasing the yield of wood alcohol in the destructive distillation of hardwoods. Efforts to secure satisfactory commercial co-operation for the determination of the value of this process have proved unsuccessful. The laboratory is not able to bear its part of the necessary expenses, and the entire modifications of equipment and risks of the enterprise would have to be thrown upon the commercial operator. This is a typical example of a good laboratory result which may go entirely to waste unless proper commercial tests and demonstration can be developed.

Wood Waste for Cattle Food

Laboratory research has developed a method of transforming sawdust and wood waste into a satisfactory cattle food. Nothing has yet been done, however, on details of the process which must be developed for successfully producing the material on a commercial scale. Methods of drying and mixing the product need commercial study, and there must be a large-scale demonstration of the value of the product. This method of utilizing wood waste offers an enormous future possibility, and the favorable laboratory results should be aggressively pushed forward.

Direct Industrial Cooperation

One method of putting the results of the laboratory's research into practical service is to undertake specific tests and investigations in co-operation with commercial interests. In such work the knowledge and experience of the laboratory is brought to bear upon the solution of a particular commercial problem. In carrying on such work it is now the policy of the co-operator to cover the complete costs of the work. Difficulties are encountered in developing it on this basis, in that many industries feel that the institution, since a Federal one, should undertake such tests for and with them without cost, or at least on some basis whereby the expense is mutually shared.

This is due partly to the fact that it is necessary for the laboratory always to retain the right of publication of the results of the work. The co-operator is many times loath to cover the costs and have the results become equally available to his competitors. Furthermore, it must be recognized that to develop such service to industry requires a certain degree of travel and field connections in order to determine the problems of specific companies and industries which require laboratory investigations. It is also necessary to explain to those in the industry the possibilities available and enlist their interest in the undertaking of the tests.

Several men could be effectively kept on the development of this phase of the laboratory's work. It is felt that more effective results would be secured in the long run if the cost of such co-operative work could be borne mutually by the Government and individual. A minimum fund of $20,000 is desired for such work for the coming fiscal year. This is approximately the amount expended during the past year, all of which was received through co-operative sources.

Industrial Uses of Gas Masks

By H. Foster Bain

Director, U. S. Bureau of Mines.

IN warfare and in industry, gases and vapors may cause three atmospheric conditions dangerous or fatal to life. First, in warfare, there are poisonous gases from shells or bombs which, as they are discharged usually in the open air, occur in low concentrations; that is, the actual percentage is small and there is no material depletion of oxygen. Second, in industries, there are sufficiently high concentrations of poisonous gases causing unconsciousness or death which may be encountered through accidents or repair work permitting escape of such gases as ammonia, sulphur fumes and carbon monoxide, though usually there is plenty of oxygen in the air for breathing. Third, in confined spaces, such as in tanks, basements and in mines, following explosions or fires, there may be poisonous gases, fumes or inert gases in such quantity that the normal oxygen content (twenty-one per cent) of the air may be so reduced that the atmosphere will not sustain life, independent of the toxic effect of the gases.

The first condition was met efficiently by the army gas masks. The second condition, high concentration of poisonous gases, fumes or vapors, but with sufficient oxygen, may be met by the use of masks with special absorbents. Army masks are valueless for carbon monoxide and high concentrations of ammonia and many other gases. Under the third condition, where there is a deficiency of oxygen, no mask is of any value. Use of the army masks and other masks under such conditions has led to a number of deaths in fire fighting, in cleaning gasoline tanks, and in entering mines in which there were fires. Such conditions can be met only by the use of self-contained breathing apparatus which supplies abundant oxygen.

Since its army mask investigations ceased at the close of the war, the Bureau of Mines has carried on intensive investigations to develop masks which would meet the second condition. A mask has been developed recently by the bureau which will allow the wearer to enter smoke and fumes given off in the open air or in large open buildings. When this mask has been made commercially, it will undoubtedly be of great value in the protection of men who work where such gases are likely to be encountered and to firemen in fire fighting in and around buildings. But, it must be borne in mind that when the third condition is present, that is, oxygen deficiency, which may occur in mines after explosions or fires, in confined spaces, in surface fires, in basements or closed rooms or where illuminating gas or gasoline vapor may be present in high concentration, as in tanks, gas conduits, or possibly sewers, or in the unventilated holds of ships, then only self-contained breathing apparatus, otherwise termed oxygen breathing apparatus, can be safely used.

When it is desired to enter a confined space such as a gas tank or a sewer where the presence of gases or deficiency of oxygen is suspected and self-contained breathing apparatus is not at hand, analyses or tests should first be made to determine the nature of the gas and that the percentage of oxygen present is adequate for breathing, that is, at least 17 per cent. Unless at least that amount of oxygen by present, the place should not be entered, even with a mask which has absorbents for concentrated poisonous gases.

In a mine in which an explosion has occurred or a fire is raging, granting that there may be sufficient oxygen where air is being circulated, there is usually, nevertheless, in the local atmosphere on the return side of a mine fire or in the inner workings of a mine where the explosion has destroyed stoppings, a deficiency of oxygen accompanying high concentrations of carbon monoxide and carbon dioxide. Moreover it can never be foretold how rapidly the atmosphere may change at a particular place in the mine where recovery operations or fire fighting is being carried on, which would make it dangerous or fatal to the wearer of a mask. Insufficiency of oxygen gives no warning. A man wearing a gas mask in such workings, while crossing a fall or roof or when at the face of an unventilated rise or dip heading, or in similar situations, may drop without warning upon encountering an atmosphere deficient in oxygen owing to an accumulation of fire damp or black damp supplanting the breathable air.

The Bureau therefore recommends on the basis of present evidence that only self-contained oxygen breathing apparatus should be used in mines following explosions or fires. There are always men willing to risk their lives to save others who would be tempted to use masks if they were on hand and the risk is larger than should be taken.

New Jersey Chemical Society

The regular meeting of the New Jersey Chemical Society on Jan. 9, at Stetter's restaurant, Newark, overflowed the assembly room and was marked as usual by the addition of new members. John A. Wilson of the Duratex Co., presided. Dr. Hugh A. Taylor, professor of Physical Chemistry, Princeton University, introduced his discussion of "Hetereogeneous Catalysis," by humorously impugning the allegation that Princeton is the biggest and finest country club in the country, thus lending point to Dr. Butler's discussion in the latter's recent annual report of Columbia University.

Charles P. [illegible] president of the New York Microscopical Society and vice president of the New Jersey Chemical Society, discussed the geographical distribution, microscopical structure, industrial uses and varieties of products of the chief commercial fibres of the world, viz., cotton, wool, silk and flax. He illustrated his talk by projections of excellent photomicrographs of fibres and fabrics and of views of associated technical subjects.

Salt Pans

Some Standard Proportions for Vacuum Pans Used in the Salt Industry.

By W. F. Downing, Jr.

PRACTICALLY every salt plant has in operation one or more vacuum pans, either a single effect or multiple effects, in which sodium chloride brine is evaporated and salt is made.

There is a great variety of sizes and shapes of pans in use the diameters of which vary from about six feet to about twenty-two feet.

The pans in use are single effect, double effect, triple effect and quadruple effect. The quadruple effect is the top limit of multiple effect in the salt industry, due to the fact that the boiling point of sodium chloride brine is higher than that of water, which produces a loss in available temperature drop. At some salt plants the several effects of a multiple effect salt pan are so piped up as to permit of dropping off one pan and operating the remainder at effect one less than the whole. This allows the pan that is cut to be repaired or cleaned.

The material used in these pans is usually steel plates for the body or shell of the pan up to diameters of ten to twelve feet. Above these diameters cast iron is used. The tube sheets may be steel, copper or tobin-bronze. The tubes are either steel or copper.

SOME STANDARD PROPORTIONS

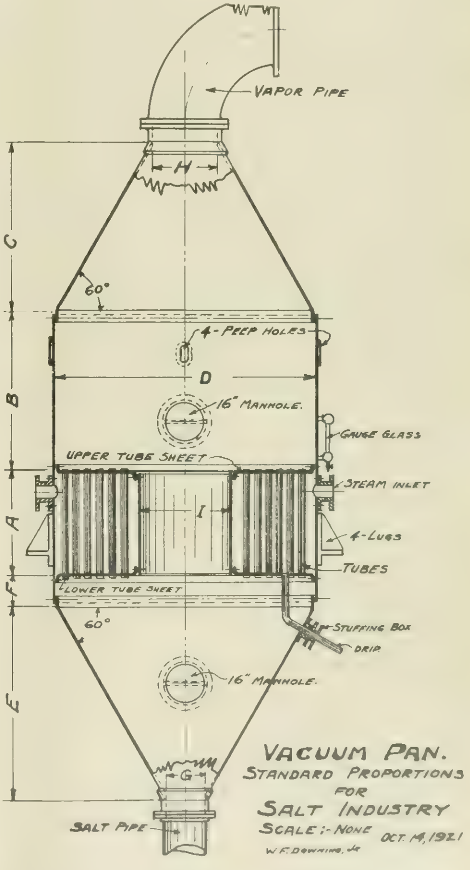
SYMBOL	DESCRIPTION	DIMENSION	DIMENSION IS IN:-
A	OUT TO OUT OF TUBE SHEETS	3'-10½"	FT. & IN.
B	WORKING SPACE	6'-0"	FT. & IN.
C	TOP CONE HEIGHT	.6×D	FT.
D	DIAMETER OF PAN	DATUM	FT.
E	BOTTOM CONE HEIGHT	.75×D	FT.
F	NECK BELOW TUBE SHEET	12"	IN.
G	SALT LEG DIAMETER	.15×D, MIN. 1⅓	FT.
H	VAPOR PIPE "	.3×D	FT.
I	DOWNTAKE "	.6×D	FT.
J	STEAM INLETS " (2-OPENS)	.12×D	FT.
K	LENGTH OF TUBES	4'-0"	FT & IN.
L	NUMBER OF TUBES	$7.75 \times D^2$	No
M	OUTSIDE DIAMETER OF TUBES	2½"	IN.
N	GAUGE OF TUBES	14	No.
O	CTR TO CTR OF TUBES	3½"	IN.
P	HEATING SURFACE	$20 \times D^2$	SQ FT
Q	CAPACITY OF PAN IN 24 HRS.	$7.75 \times D^2$	BBLS.
R	VELOCITY OF BRINE THRU TUBES	30	FT. PER SEC.
S	" " " " DOWNTAKE	3	" " "
T	" " VAPOR	300	" " "
U	" " STEAM AT INLETS	100	" " "
V	STEAM PRESSURE	5	LBS.
W	VACUUM	27	IN.

The tendency is now, probably more than ever, towards a standardization of the sizes of tubes, pan diameters, tube lengths, etc., in the construction of vacuum pans for making salt.

The tubes most generally used are 2½-in. o. d. tubes, and in most pans especially the smaller ones the tubes are 48 inches long. In the larger pans the tubes may be up to a maximum of 72 inches in length, but this length is seldom used unless artificial means of circulation is resorted to. The 2½-in. tubes are spaced 3½-in. centers and thus you can get 13½ tubes in a square foot of tube sheet. However, in estimating the number of tubes in a tube sheet allowance must be made for the spaces lost at the outer and inner edges of the tube sheet.

The capacity of a single effect salt pan is, roughly, one barrel of salt of 280 pounds in twenty-four hours for each 2½x48-inch tube, or, one barrel of salt of 280 pounds for each 2½ square feet of heating surface in twenty-four hours. In other words, the capacity of a single effect salt pan in barrels per twenty-four hours is, roughly, equal to the number of four-foot tubes that it contains. This figure can be exceeded considerably if the pan is clean and artificial circulation is resorted to.

The efficiency of salt pans is generally 70 to 80 per cent. The salt made is usually, for single effects, 12 to 14 barrels of salt per ton of coal; for double effects, 21 to 24 barrels of salt per ton of coal; for triple effects, 33 to 36 barrels of salt per ton of coal and for quaduple effects, 42 to 46 barrels of salt per ton of coal. The above figures depend upon the grade of coal used.



VACUUM PAN.
STANDARD PROPORTIONS
FOR
SALT INDUSTRY
SCALE:- NONE OCT. 14, 1921
W. F. DOWNING, JR.

The diagram and table shown herewith give "Some Standard Proportions" for salt pans, and the writer believes that this tabulation will prove both useful and unique, not only to the designer of but to those operating salt pans. You will note that practically all of the dimensions indicated in the table are given in terms of the diameter "D" of the pan. Thus, if you know the capacity of your pan you can determine immediately the diameter "D," from [illegible] of the pan may be determined. It is hardly necessary to state that there is quite a divergence from the above tabulated standards by many designers, but the values here given have proven quite satisfactory.

The body or shell of the pan as shown in the sketch is in its simplest form. Frequently designers resort to refinements in developing it, such as sloping the upper portion of the body outward, forming a protruding steam belt around the calandria, or as is done in some large pans placing baffles in the steam belt to permit of a better steam distribution, or nesting the tubes more closely together at the steam inlets and spreading them at the points most remote from the steam inlets.

If the designer who attempts to apply the tabulated values herewith given will keep in mind the several facts of his problem, and make the proper allowances where necessary, he will find that he will not go any further astray than when using any other set of values where an attempt has been made to establish a set of standards, wherein the material used in the construction and the other conditions vary to such an extent as they do in the construction and proportioning of salt pans.

Cogitations on the Chemist

STROUD JORDAN, Ph.D. ('09, Uni. of N. C.), chemist, Henry Heide, confectioner, New York City, in the December number of *The Carolina Chemist*, the journal of the chemical department of the University of North Carolina, discusses the economic problems of the chemist in a way to provoke its editor to say: "Whether you agree with the thought in this article or not, you should read it. Certainly the writer opens a field for discussion. He has been out in the industries and is in a position to give the reader the viewpoint of the salaried chemist."

We are interested in Dr. Jordan's confirmation of our opinion that chemically trained men are being turned out at a faster rate than industry can absorb them in strictly chemical employment in production; that chemical education must receive more emphasis for its disciplinary value and as a basis for specialization in work in every department of chemically controlled enterprise; that the material problems of chemists demand economic organization for their specialized study. Dr. Jordan's answer to his own question, viz., why should over 90 per cent. of the chemists turned out from college look forward to "getting a job?" we are inclined to feel lacks that keen edge of practicality which one might say is characteristic of the chemist as a class. Dr. Jordan's remarks follows.

On all sides you will find chemists bemoaning the fact that so many of their ranks are out of work and looking for possible locations. This is for the most part due to the overcrowding of the ranks during strenuous times when so many entered the profession who were not fitted for anything but emergency service. They should enter college again and take a certain amount of graduate work for use in their professional work, since a graduate degree is almost a requisite if one wants to become more than a mere analyst.

In direct contrast to this state of affairs is the fact that you will not find factory superintendents, managers, and even foremen laid off as were the chemists. The organization seems to need the services of everyone more than the chemist, and when the axe falls the chemist is one of the first to suffer.

I will not agree with this stand, but nevertheless it is a fact. Look around and then ask yourselves why this state of affairs exists. It can only be explained by the fact that a chemist may be "fired" and another taken in to fill his place on short notice, just as a bookkeeper or clerk, and progress not be hampered to any great extent. Not so with the factory organization, for every cog in that wheel is necessary and the organization must be kept intact, even in the most trying times.

Why isn't the chemist as necessary as any other cog? The answer to this question is that he has been content to stay in the laboratory and knows little or nothing about production methods. He couldn't take charge of and run the plant if the manager should be fired or die but why shouldn't he be able to do this very thing? We must be more practical and delve into actual production if we would be a necessary asset.

Wherever a chemist has been held on in an organization he has been credited with doing work which shows in the profit column and is not charged off to red figures at the end of each year. The managers of business can be persuaded of the necessity of any department only by actual figures of savings made or profits earned by that department, and if the chemists are willing to draw their salary and make monthly reports, or whatever reports are required, and never show the financial side of such reports then they never get the credit for their work. The old adage, "Do not hide your light under a bushel," is just as true now as it was before the Phlogiston theory was exploded.

Now to hit the mark intended in this article on the chemists of the future, it is necessary to point out briefly that the positions where a chemist is hired are necessarily limited and will not keep apace with the production of chemists of the future; so that new outlets must be looked up. I am referring now to the practice of chemistry as a profession, just as a lawyer or a doctor practices his profession. How many lawyers or doctors do you find who contemplate working for some corporation or for a salary? Why should over ninety per cent. of the chemists turned out from college look forward to "getting a job?" Why haven't they a job already picked out to work for themselves? What have they done with their time in college along research lines? Why have they not picked out problems which would give them ample work to carry out after college days are over?

The South is teeming with possibilities for manufacture and development where a chemist may start with little capital and build a business for himself in which he is his own paymaster. The undeveloped resources at your command are unlimited and it needs only a legitimate amount of search to uncover possibilities which will pay you far more than a salary with some corporation.

Lay out your research along practical lines and do those things which may be translated into the upbuilding of business, if you expect to go into industrial work; and be ready when you finish your work to start working for yourself. Rest assured that if you are worth a given amount to an individual or corporation that you are certainly worth more than that to yourself. Any corporation who pays a salary expects to make a profit on that salary or it is discontinued.

The chemists of the future must look forward to working for themselves rather than working for some corporation on a salary basis, and in this way the profession will be built up, for the more chemists are productive for themselves, the more the world will see the necessity of the chemist and his work

Silicate of Soda

Its Function in the Cleansing Process. Expansion of Its Use as a Detergent.

By James G. Vail

Chemical Director, Philadelphia Quartz Company

WASHING, although to civilized people one of the most familiar of all processes, has been one of the most baffling to those who would explain the chemical and physical phenomena which produce the familiar results. In spite of a great deal of study, the methods by which we clean our hands, clothes and dwelling places, are still largely empirical. Until we have a better understanding of the mechanism of the process itself it is not likely that we shall attain either the greatest economy or the most satisfactory results. A washing compound may dissolve the dirt; it may suspend it in a froth and carry it away; it may produce an emulsion; it may simply lubricate the foreign substance and allow mechanical processes to do the rest. Which of these is the most effective and in what degree or whether other factors are more important is not positively known.

Experience goes a long way in the selection of products and processes which are effective. Science often shows the inner workings of long established practices only to confirm their merit. The Egyptians knew the use of straw in their bricks long before Acheson showed that the extract of the straw increased the plasticity and strength of the clay. Generations of human experience tend to preserve the practice which is good and to reject the useless. This often happens before the scientific method can be applied, and, when it is applied, few products which have been in wide use for many years are found to be without value.

Silicate of soda as a constituent of domestic laundry soap has for a long time given and continues to give useful service and general satisfaction. It was first introduced into the United States as a detergent. It has good cleansing properties of its own and was for a time used in this way, but the convenience of a solid compound plus the demand for a washing compound that will lather, established the practice of using it in admixture with soap. This has been general for more than fifty years. Silicate of soda is much cheaper than soap and on this account rather than on a consideration of the service it can render, it has been regarded as a filler or even as an adulterant for soap. As a matter of fact, the cheap attractive cake of laundry soap to which we are accustomed would not be possible if it contained nothing but soap and water. It would have to be made from more costly fats or oils or be subject to a higher manufacturing expense. The other horn of the dilemma would be a sacrifice of texture, solubility and washing power.

We should separate in our minds the consideration of cost and the consideration of performance, and try to find out what evidence there is of merit for silicate of soda as a detergent. If its wider application is right, further economies will be possible for all of us.

In England and on the continent of Europe, washing powders consisting of sodium carbonate and sodium silicate only are sold under a variety of names and are very popular; partly because they are cheap, but also because they are serviceable. Now it is well known that the continued use of pure sodium carbonate as a detergent is accompanied with the graying of cotton fabrics, but in the case of a carbonate silicate mixture, the reverse has been observed so often and so consistently as to imply that silicate of soda has bleaching properties. Whatever the cause of this whitening effect it can be shown that it is not due to the deposit of any white substances in the fibre or to any process which is accompanied with loss of strength sufficient to be observed.

Measurements recently made at the Mellon Institute of Industrial Research in Pittsburgh, show that repeated washing in sodium silicate solution does not adversely affect the strength of cotton fabrics. In the process of bleaching with hydrogen peroxide, which must be done in an alkaline bath, the most satisfactory results are secured if sodium silicate is used as the means of making the bath alkaline. Comparative tests conducted in our laboratory showed that for the fabrics examined, better bleaching effects were secured from the same quantities of peroxide and alkali, if the latter was added in the form of silicate than when it was added as caustic soda. The inference that the silica in the solution has something to do with the color of washed fabrics does not seem unreasonable.

One of the properties required of a good detergent is the ability to lubricate particles which it is desired to remove. Silicate of soda is again indicated because its solution has this character in a marked degree. We have become thoroughly accustomed to thinking that an abundance of lather is essential to effective washing, but recent experiments conducted over a period of months in a large commercial laundry show that thoroughly satisfactory work can be obtained at a marked saving with a silicate of soda mixture, the lathering properties of which are much below those of pure soap such as is ordinarily used in this work. Here it has been observed that where the bleaching with hypochlorite is done in the suds the lather persists better in the presence of bleach when the silicate of soda is present. Rasser[1] states that sodium silicate increases the solubility and lathering power of soap.

Washing in cold water has many advantages. It has been pointed out that to be effective the detergent must be soluble in water of the temperatures in question. Silicate of soda of commercial grades, once it is in solution, is freely soluble in water and may readily be rinsed out after washing is completed.

Many writers have deemed the colloidal characteristics of detergents to be of primary importance. Even insoluble materials such as colloidal clays have been proposed. Silicate of soda as it is known in commerce is essentially a colloidal material. The boiling and freezing points of its solutions even at high concentration vary but little from the boiling and freezing points of water. The relation between alkali and silica is not limited by the composition of definite sodium silicate compounds, although the compound Na_2SiO_3 is known and can easily be prepared. All commercial products contain much more silica than is indicated by this formula. The grade most widely used for detergent purposes contains more than three times as much.

The condition of the alkali in sodium silicate solutions used for washing is worthy of attention. As Stericker[2] has pointed out, due to the colloidal nature of the solutions, the extent to which the alkali is free or combined is a difficult matter to determine. From a practical standpoint, however, its behavior is very much different from the behavior of free caustic soda. The values of free alkali determined by the hydrogen electrode are surprisingly small, although they increase with dilution as do similar values for soap. A solution of caustic soda containing eight per cent. of sodium oxide will, in a few hours, attack ordinary tin plate and darken it. A solution of silicate of soda of the ratio generally used for washing (1 : 3.25) will not tarnish the same plate at atmospheric temperatures, though it be left immersed for months.

---

[1] [illegible] A. 15.2992.

[2] *Chem. & Met. Eng.* Vol. 25, No. 2, P. 61-7/13/1921.

The effect of silicate and caustic on the hands is very different because the silica in the solution modifies the action of the alkali. Of interest in this connection is the fact that addition of sodium silicate to a freshly made soap containing free alkali as determined by standard methods will reduce the amount of that free alkali, and in making silicated soaps it is necessary to add extra caustic to be taken up by the silicate solution.

It is evident that there remains a great deal of work to be done, not only to discover the mechanism of the washing process considered broadly but to determine what part sodium silicate may rightly play in various particular applications of the washing process. Work is now being undertaken at the Mellon Institute of Industrial Research in Pittsburgh in co-operation with the Multiple Industrial Fellowship which devotes itself to the problems of laundries. Here a further examination will be made into a series of surprisingly favorable practical experiments with silicate of soda. These have shown that washing of completely satisfactory quality can be turned out at a much lower cost for materials than has been considered possible. The conditions as to materials washed, time required, apparatus and intelligence needed are ordinary conditions. The indications are that silicate of soda, already used in a great variety of ways, is capable of rendering a much extended service in washing. Investigations to determine the type of silicate of soda which will be most suitable and the best conditions for its use are being made at the Mellon Institute of Industrial Research and will be reported.

The present suggestion is made with the hope that the subject may be considered from many angles, and in the light of a more varied experience than that of any single individual.

Imparting to Vegetable Fibres the Characteristics of Wool

THE treatment of vegetable fibres to impart to them the characteristics of wool both physically as to feel, appearance and heat-retaining quality, and chemically as regards their affinity and absorbent capacity for dyes, is the subject of U. S. Letters Patent No. 1,400,381, granted Dec. 13, 1921, to Charles Schwartz, a French citizen. According to this patent it has been found that these qualities can be imparted to cellulosic fibres when the products of a suitable slow dissociation of protein bodies by strong mineral acids are fixed thereon.

The products of the dissociation are solutions which are precipitated by the addition of water.

To obtain this result either the fabric to be treated is impregnated with the liquor of dissociation, the latter squeezed out and the material washed, or the fabric is impregnated with the usual protein solutions and then treated with the hydrolyzing liquid, squeezed out and washed. In either case there is formed upon the fibre, and closely integral therewith, a precipitate of the intermediate insoluble product of the dissociation of the protein body.

The following proteids, casein, egg-albumen, serum-albumen, and gelatin, are very favorable for these reactions.

Hydrolyzing agents which begin to act at the ordinary temperature and are therefore specially suitable for this purpose, are: 65-80 per cent. nitric acid; 55-65 per cent. sulfuric acid; 25-37 per cent. hydrochloric acid; phosphoric acid of 55-57° Bé. These acids may be employed together. The time of immersion and the temperature are regulated according to the nature of the fibre, the protein substance employed, and the element which serves to effect the dissociation. This dissociation may be sufficiently affected in a few seconds, as in the case, for example, of casein with 65 per cent. sulfuric acid, or may require some minutes as occurs with nitric acid.

A variation of temperature from 5° C. to 20° C. has no appreciable influence upon the result obtained. Precipitation is produced by merely washing the treated fibre in water.

As primary substances for carrying out the process, there may be employed not only the proteids as such but also the products of their transformations, as for instance their combinations with formaldehyde or tannin. In the same way the precipitates formed on the fibre may be treated with bodies which form stable compounds with the proteids, as for instance formaldehyde or formaldehyde and ammonia.

The process is applicable to all vegetable fibres, both natural and artificial, in all forms and in any stage whatever in the operations to which they are subjected in the textile industry, whether they are in the mass or in the state of lap, cops, card-ends, twisting yarns or fabrics, and whether these fibres are mercerized or not. This treatment of the fibre may be regarded as a preparation for the usual processes of dyeing and printing.

Example I.—The fibre is impregnated with a slightly ammoniacal solution of casein, containing 10 per cent. of the latter, dried, and submitted for some time to the action of formaldehyde vapor; it is then treated for two minutes with 75 per cent. nitric acid at the ordinary temperature, squeezed or pressed out and washed. The yellowish color of xanthro-proteid developed by a secondary reaction easily may be removed by treatment with weak carbonate of soda solution.

Example II.—In the former example, the 75 per cent. nitric acid may be replaced by a mixture of 85 parts of nitric acid of 40° Bé. and 15 parts of sulfuric acid of 52° Bé.

Example III.—In example I, the 75 per cent. nitric acid may be replaced by a mixture of 92 parts of nitric acid of 44° Bé. and 8 parts of phosphoric acid of 45° Bé.

A study of the unsaturated hydrocarbons in industrial gases is being made by the Bureau of Mines with a view of developing economic methods for the manufacture of alcohols from them. Ethyl and propyl alcohols in particular are being sought. Gas distilled from a mixture of oil and coal is at present being studied in co-operation with the Trent Process Corporation, of Washington, D. C.

Cheap Oxygen

A Consideration of Its Application to Chemical Processes in Metallurgy

By Anson G. Betts

Chemist and Mining Engineer

THE suggestions of E. A. W. Jefferies regarding the use of cheap oxygen, presented in October CHEMICAL AGE, touch upon the improvement of existing manufacturing processes through the contemplated substitution, in part or in whole, of air, by oxygen.

Cheap oxygen in combination with fuels, greatly extends the possibilities of metallurgical and chemical processes, but more particularly those processes which, with air, are at least near the boundary line between the possible and the impossible. For an easy reaction, such as the reduction of litharge or lead oxide by carbon, which requires a relatively low temperature, the possibility of applying oxygen to advantage seems far more remote than would be the production of ferro-manganese, for example, which depends on a chemical reaction, almost without the practicable bounds of an air-and-fuel process.

Silicon, manganese and chromium are more difficult of reduction by a fuel-smelting process than iron. The production of the corresponding ferro-alloys in a blast furnace as contemplated by Mr. Jefferies, would appear to offer a more inviting opportunity to cut relative costs than the manufacture of pig-iron. That is to say, if an oxygen-supplying plant is added as an accessory to an iron blast-furnace, it would seem that such a plant under present conditions and prices, would have a greater opportunity to profit by manufacturing a ferro-alloy than pig iron.

The use of fuel plus oxygen instead of fuel plus air as a source of heat in effecting chemical reactions, particularly between oxides and carbon, i. e., reduction processes, opens possibilities of a development, though perhaps of more limited range, similar to that which already has been realized by electric furnaces. The electric furnace is a relatively expensive instrument to instal and operate compared to fuel furnaces of equal capacity. It has been called into use mainly for purposes impracticable or nearly so for fuel-air-heated operations. Widening the scope and possibilities of the fuel-heated operation or process by the use of oxygen instead of air, would tend to expand the field of the fuel process at the expense of the field of the electric process, and therein cheap oxygen would be apt to find the most ready and valuable application.

The manufacture of ferro-chromium is left mainly to the electric furnace, while the field of manufacture of ferro-silicon and ferro-manganese is occupied by both the fuel and the electric furnace, the lower percentage alloys being made in the blast furnace. The introduction of oxygen in the blast of the ferro-silicon or ferro-manganese furnace is bound to increase the practicable range of its possibilities with respect to the percentage of silicon or manganese in the product.

Aluminum is still more difficultly reducible and is practically unreducible by a fuel process, although there appear to be well authenticated cases of reduction in a minor way in iron blast furnaces, with the production of ferro-aluminum with up to 1 per cent. aluminum. However, by increasing the temperature in the iron blast furnace, the reduction of larger amounts of aluminum into the iron may be achieved, and this increase of temperature can be brought about by the agency of an oxygen blast. Ferro-aluminum thus produced might and probably would find direct application in metallurgy, or it may be used for the production of aluminum metal itself, for example, by electrolytic refining.[1]

Another process[2] consists in treating the melted ferro-aluminum with melted iron sulphide, with the reduction of iron and production of aluminum sulphide, which may then be reduced to aluminum in a way similar to the electric process at present in use on a large scale, for the reduction of pure aluminum oxide to the metal; only in this case with the recovery of the sulphur liberated at the anodes as a by-product. In the reduction of aluminum oxide there is a considerable combustion of electrode carbon, which constitutes one of the major elements of cost entering into the production of aluminum as at present carried out, which expense may be eliminated very largely by the aforesaid use of the oxygen blast. Another large item of expense at present in making aluminum is the necessary chemical purification of the aluminum oxide, which also can be obviated in this way.

As a competitive method of producing aluminum, oxygen-smelting to ferro-aluminum in a blast furnace, followed by the removal of the aluminum from the alloy by reaction with iron sulphide would obviate the now necessary preliminary preparation of pure alumina, would remove practically the electrode expense in the electric reduction, would reduce the consumption of electric power by perhaps half due to the easier reducibility of the sulphide, and incidentally would convert some raw iron sulphide into iron and sulphur. Raw iron sulphide is available in any amount at low cost, as it can be produced very cheaply by running pyrite or pyrrhotite through a copper-matting furnace, or cupola, which is practically the operation of the copper-matting furnace, except that the copper-matting process usually is operated in a way to burn a part of the iron sulphide and throw a large part of the iron into the slag and a minor amount into the matte. Very large deposits of pyrrhotite and pyrite are common in many mining regions but are not utilized to any great extent except in some cases as a source of sulphuric acid. There is at present no large operation anywhere looking to the recovery of the sulphur and iron, so that such deposits are generally considered practically valueless, although of very great extent.

There is of course no physical reason for the preparation of oxygen from air being expensive, but hitherto there no doubt have been business reasons why the manufacturers of oxygen were content with the 6 per cent. efficiency stated by Mr. Jefferies, instead of the 60 per cent. which he realizes, because the over-all difference in cost of delivering one cubic foot of oxygen in cylinders to the customer, could have been the same, or even less at 6 per cent. efficiency than at 60 per cent. efficiency from a power standpoint, if the power cost is a very small element in the total cost.

Realizing that the preparation of oxygen by the ton for use on the premises of course involves entirely different considerations from power and other standpoints than does supplying it in cylinders [illegible] amounts, it is gratifying that this larger and more important field is [illegible] of oxygen at such a figure as $2 a ton is even in contemplation.

---

[1] U. S. [illegible]

[2] U. S. Patent [illegible]

CHEMICAL
AGE

Volume 30
Number 1

January
1922

A Consolidation of
The Chemical Engineer
and Chemical Age

EDITORIAL

CHEMISTS should view with chagrin the mental predilections of that member of the tribe honored above all others by a seat in the United States Senate. Is there something in the drear monotony of the wind-swept, treeless plains of North Dakota and their sparse population that would turn a Maine Yankee into a "populist" with peculiar ideas as to class relations in a republic?

We share with Dr. Ladd his keen sympathy for his constituents who, producing chiefly wheat and cattle, seem to be victims of the weather and of world- market conditions, but we, as do many others equally patriotic, condemn his convictions that economic law can be flouted by class legislation and that the methods of the Non-Partisan League that brought North Dakota to discredit can be worked to national advantage at Washington.

Chemists, as is the public generally, are vitally concerned with the sway of the pendulum of class control in national legislation, for upon its wise adjustment depends the resumption of industry. With stop-watch in hand, under threat of civil war, organized labor forced special legislation in its behalf from whose evil effects all have suffered. Today reckless politicians in the name of agriculture seek to weaken and pervert national institutions and to lay upon the back of the taxpayer burdens that their class control may be insured.

THE present situation at Washington has further and more serious import on the recovery of business, and so demands the earnest observation of everyone who has a stake in industry. Let it be known that the nations fall into two main trade groups, viz., those predominantly exporting raw and semi-manufactured goods and importing manufactured goods, and those importing raw materials and semi-manufactured goods and exporting manufactured goods. Obviously, reciprocal trade is essential to their respective existence.

Foremost in manufactured goods and in the production of raw materials, the United States belongs to neither group; moreover, we import heavily both manufactured goods and raw materials. That we can be sufficient unto ourselves is disproved by the plight of agriculture and industry in America today. We come to the same conclusion that we have reached before on this page, viz., that the world problems must be settled first before in their progressive solution in a measure will disappear the clash of class interest and the spurious panaceas of the demagogue.

And so we submit respectfully and cordially to Senator Ladd, who knows the lingo of the laboratory and the pulling and hauling of politics, that the restoration of the gold standard in Europe is paramount to the perpetration of fiat money in America; that balancing the budgets of European countries is vastly more important to American agriculture than a bonus bill; and that a balanced trade, expressed in approaching parity of exchange, will do more to temper the North Dakota winters than all the embarrassment that an agricultural "bloc" can inflict upon sound legislation under our party system of government.

THE decline in farm crop values from 13½ billions in 1919 to 8 billions in 1920 and to 5½ billions in 1921 received its initial impetus from the loss of foreign purchasing power for the surplus products of the soil, whose values are determined by the play of supply and demand in the open markets of the world.

Do manufacturers, whose activities create the domestic demand for farm products, need to be reminded that they likewise have suffered losses of similar proportions, those consequent upon the inhibition of rural purchasing power being indicated by the above figures and estimated at 40-50 per cent. of the buying power of America? These losses, as represented by unemployment, have permeated the rank and file of industry and created hardship contributing further to inability to buy.

The turgid stream of agrarian unrest has its source in the artificially restrained deflation in what the farmer, and consumer generally, buys; whereas what he has to sell suffered precipitous declines in value. Long after the public would buy at any price, labor demands a wage rate which the manufacturer no longer can pass along in the price of goods. That he has endeavored to do so is evidenced by high judicial condemnation of means to that end.

Do you not see that interference with Nature's methods of guiding the energies of man surely breeds further evils whose clashing progeny strive for exclusive advantage and class legislation with their favoritism not only fatal to the general good but a delusion to those it is designed to serve?

The disappearance of an unprecedented market, with its imperative and painful readjustments, and the laggard appearance of a normal market, with its stabilized correlations, are seized upon by a group of politicians as an excuse for reversion to communism. Legislation for the supposed advantage of a class, when all human experience shows its futility and injury to all, can be explained only by the cowardice and indolence of men who see in the right way the hard way and who feel that in feeding a delusion they are strengthening themselves.

HENRY FORD asserts that he desires Muscle Shoals not for "selfish purposes," but to establish an "industrial philanthropy," to effect which paternalistic project he seeks, upon invitation, a great war-time investment at a salvage price, together with additional millions of tax-raised money to complete the Tennessee River dams.

Paternalism in government becomes doubly odious when class favoritism is linked with largess to individuals who have their own axes to grind.

Such procedure is revolting to the spirit of American institutions, and if persisted in, as is sought on all sides by disaffected groups of our people, bodes ill for the Republic.

We do not want in American business such an incongruous thing as government-aided, private philanthropy in the production and distribution of goods. If a hydro-electric development can be had only on such a basis, it were better to dispense with the improvement.

The wisest course is for the Government to preserve the Muscle Shoals Nitrate property in a standby condition, as at present, for possible application to its original purpose.

BURDENED justly with the penalty of defeat in her dicer's throw to make a subject world, Germany gambles now with its prosperity, if not its peace, to escape the payment of this penalty. The irony of the situation lies in that whatever effort at amends is made is at the temporary misfortune of the Allies. The chief difficulty is the discovery of a method of exacting payment from the debtor without destroying in the process the industry of the creditor. Reparation payments in the final analysis are a one-sided transfer rather than an exchange of goods.

The discerning see in the depreciation of the mark the premeditation of the "German psychology" to make impossible of accomplishment what she does not want to do. The contradiction of the bankruptcy of the government and the prosperity of the nation would seem to confirm the view that while Germany failed in 1914-18 she may win her goal in 1920-30.

In pursuance of this apparent plan, possible only in a strictly regulated country like Germany, the creation of concealed foreign credits and resumption of pre-war "peaceful penetration," disclosed already in Italy, would confirm the aim to acquire, wherever possible, a strangle hold on the commerce and finance of other nations. America's place in the plans of the German captains of industry measures up to the richness of our market.

WE appreciate, in a period when chemists find it hard to make both ends meet and when many in the stress of unemployment have given up the attempt, with what delicacy the subject of thrift must be discussed.

We appreciate the state of mind of a class of men trained at great expense for the work of production, who, under the pressure of increasing sensitiveness to the stimuli of needs, must perforce develop a callousness, which the plumber, for instance, is not called upon to assume.

The most important thing in a chemist's life is a job. At any rate his wife thinks so and we are satisfied to leave to her, who at one time may have preempted that position, the confirmation of our opinion. A job and its emolument depend upon capacity and an opportunity to display it and determine whether or not there may be a wife and a home with deeper roots in permanency than those possessed by a furnished room or a kitchenette apartment.

If there is a character that outshines all the great personalities of chemistry as worthy of the chemist's regard and whose precepts should rank with those of the law-givers of his science, that character is Benjamin Franklin.

Franklin's thrift was not an end in itself, for sterile accumulation played no part in his career. It was a means to ends whose realization in many lines of research and endeavor in the primitive conditions of his time made him one of the great figures of American history and an inspiration to all who would make the most out of themselves.

We commend to American chemists the consideration of Franklin's crystal common-sense, and submit Rule V of his moral code framed for himself in his early twenties: "Make no expense but to do good to others or yourself—waste nothing."

Another, 2,000 years ago, said the same thing with an idealism that marks an era in man's slow growth, but Franklin as a high priest and prophet of the commonplace gave it an intimacy of application to one's material affairs that rank Poor Richard's Sayings with Aesop's Fables among the premier precepts of the world.

How naturally Benjamin Franklin today would advise chemically educated men to gather together to consider the problems of their material welfare and to seek their solution in a way to be most helpful to the community and to themselves. From his advice would follow organization along state lines, with their respective professional organizations, just as naturally as the University of Pennsylvania grew from its humble beginnings at his hands.

Counsel grounded in practical experience and conforming to the principles of human progress and to the need and trend of the times, and hence sound. well can await its application pending the operation of the educative process and the realization on the part of those satisfied with things as they are that the tide is flowing past them.

New Catalyst in Lead Arsenate Manufacture

LEAD ARSENATE of commerce exists in two well defined forms, the acid arsenate and the pyroarsenate. The commercial variety is of recognized importance for use as an insecticide. As manufactured, the product may vary in its proportions of the two forms of arsenate dependent upon the quantities of the ingredients used and the conditions under which the manufacture is conducted.

It is well known that an arsenate of lead may be prepared by dissolving a salt of lead in water and adding to it a combining weight of arsenic acid. Alternatively litharge has been treated with an acid, preferably acetic, and the resulting lead salt precipitated with arsenic acid. While attempts have been made to produce the arsenate by the direct action of arsenic acid upon litharge, the results are not satisfactory commercially due mainly to the slowness of the reaction. Various means have been suggested to increase the speed of reaction by utilizing compounds or reagents operating in a cyclic or catalytic manner, for example the ordinary acids of industry, nitric, acetic, or the like. Such processes, however, are subject to the disadvantages resulting from the strength of these acids, the danger in handling them, difficulty and restrictions of their transportation and expenses of manufacture.

It is an object of the invention of John Kirby, Mathew S. Hopkins and Charles B. Bernhart of Reading, Pa. (U. S. Letters Patent No. 1,398,267) to employ in the preferred reaction a catalyzer which is cheap, safe in handling, readily transported and non-corrosive. They state that they have discovered that the sulfonic acids of the aromatic hydrocarbons make excellent catalyzers, that they are inexpensive to manufacture since many are the by-products of other industries, and that they are readily transported in their usual liquid or solid form. Also the purity of the sulfonic acid used is relatively non-essential as a mixture of sulfonic acids obtained by the sulfonation of the commercial grades of these hydrocarbons will act effectively. In addition, the lead arsenate produced by the use of these reagents possesses in a marked degree the physical requirements important for an insecticide, namely, large bulk, good dispersion, proper adherence to the foliage treated and effective insecticidal properties.

One mode by which this invention may be carried out consists in sulfonating a commercial grade of an aromatic hydrocarbon, such as ordinary naphthalene, in the usual manner, removing any excess of sulfuric acid by suitable means such as by precipitation with a lead salt. The clear liquid resulting after filtration or decantation consists of a mixture of various sulfonic acids of naphthalene and constitutes the catalyzer used in the process.

Carrying Out the Process

A charge of 200 pounds of litharge is placed in a tank and thoroughly agitated and kept in suspension in water. About 50 pounds of mixed sulfonic acids are then added, the quantity to be used depending upon the speed of reaction required and the physical properties desired in the product. About 600 pounds of arsenic acid (78% H_3AsO_4) is then added slowly with constant agitation. The temperature is raised to about 160° F. The mass gradually changes in color to white and the litharge is converted to lead arsenate, leaving a small excess of litharge, which [illegible] be removed, is [illegible] by the addition of more arsenic acid. The resulting mass of lead arsenate, the lead salt of the sulfonic acid and water may then be washed by any of the usual methods and the lead arsenate pressed for use as pulp, or as powder after drying and grinding.

Precipitation of the lead arsenate will leave the sulfonic acid available for the treatment of a further quantity of litharge, already present in large excess, and so a small quantity of a sulfonic acid—much less than would be required to combine with all the litharge present—may be used in this cyclic or catalytic manner to convert a large quantity of litharge into lead arsenate.

The inventors state that lead carbonate or basic lead carbonate may be used in place of litharge, that a soluble arsenate may be substituted for the acid and that the mixed mono or polysulfonic acids which are obtained by the sulfonation of benzene, anthracene, phenol, cresol, naphthol, anthraquinone, or naphthionic or anthranilic acid may likewise be used as catalyzers in place of the acids formed from naphthalene. The above reactions may be expressed, as follows, X representing a hydrocarbon compound of the aromatic series:

$PbO+2(XSO_3H=Pb(SO_3X)_2+H_2O$, or

$PbCO_3+2(XSO_3H)=Pb(SO_3X)_2+H_2O+CO_2$

$Pb(SO_3X)_2+H_3AsO_4=PbHAsO_4+2XSO_3H$, or

$3Pb(SO_3X)_2+2H_3AsO_4=Pb_3(AsO_4)_2+6XSO_3H$

Colored Nitro Cellulose Compositions

Lester J. Malone, chemist with the Eastman Kodak Co., Rochester, N. Y., makes colored nitro-cellulose compounds of a high degree of uniformity, as would be required in film manufacture and varnish making, by dyeing the nitro-cellulose upon the completion of nitration and thorough removal of the excess nitrating acid, and while it still retains the fibrous structure. The dye, preferably acid and in aqueous solution, penetrates thoroughly and uniformly the structure of the fibre.

In the solution of the colored nitro-cellulose in appropriate solvents for the preparation of compositions or dopes, the high uniformity of color in the fibre presists into the dope with a minimum amount of mixing. The intensity of color of the finished film or varnish is a function of time, temperature and strength of the dyebath into which the wet, washed nitro-cellulose is immersed.

Jingles of Science

Editor CHEMICAL AGE:

I am making a collection of verses, whose subject matter relates to some one (or more) of the sciences, with the intention of publishing an anthology of such verse, under the title of "Jingles of Science." It has occurred to me that there may be a large amount of such poetry, (the greater part of which probably has not been published) in the possession of the scientists and engineers of the country. Will you kindly grant me space for this appeal to your readers to send to me copies of such verses, together with the names of their authors, at my address, No. 7 St. Paul St., Cambridge, Mass. Such verses sent to me will be sincerely appreciated and duly acknowledged.

You may be interested to learn that Mr. Ellwood Hendrick has promised me his co-operation, so the success of the venture is assured.

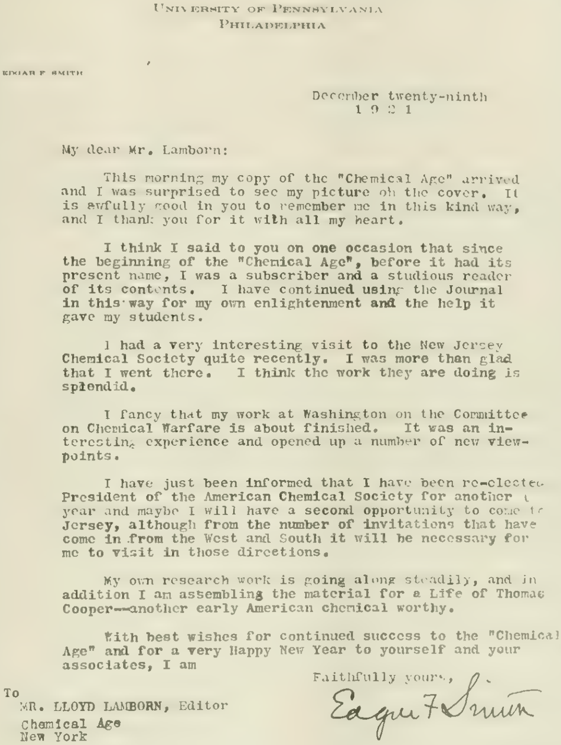
DR. CHARLES E. RURY

American Institute of Chemistry

PERUSAL of the initial article on page 7 on the Canadian Institute of Chemistry by its secretary, Harold J. Roast, will suggest the applicability of such a professional chemical organization to American conditions, with such obvious reservations as are suggested by our geography, system of government and distribution of industry, but which in no wise detract from the soundness of the idea and the certainty of its eventual consummation.

We have pointed out with some measure of reiteration that system of chemical segregation best suited to the development of the potentialities of chemically educated men. This system has a dual aspect of service, on one hand, to the state through the instrumentality of the state chemical society devoted to the promotion of chemical enterprise within the state, under autonomous government; and on the other hand to the recognition and development of chemical capacity as expressed in the state professional organization of chemists, which would represent the crystallization of ability from the mass of the membership of the state organization.

It is conceded on all sides that in America the professional chemical society must be built along state lines because of the requirement of conformity to our system of state sovereignty, which is followed by every organization dedicated to the inculcation of standards of capacity in every line of work characterized as professional. This arrangement happily conforms with the system of segregation we have advanced and which in its operation would provide the most effective means and opportunity to develop the men and resources of applied chemistry within the state.



University of Pennsylvania
Philadelphia

Edgar F. Smith

December twenty-ninth
1 9 2 1

My dear Mr. Lamborn:

This morning my copy of the "Chemical Age" arrived and I was surprised to see my picture on the cover. It is awfully good in you to remember me in this kind way, and I thank you for it with all my heart.

I think I said to you on one occasion that since the beginning of the "Chemical Age", before it had its present name, I was a subscriber and a studious reader of its contents. I have continued using the Journal in this way for my own enlightenment and the help it gave my students.

I had a very interesting visit to the New Jersey Chemical Society quite recently. I was more than glad that I went there. I think the work they are doing is splendid.

I fancy that my work at Washington on the Committee on Chemical Warfare is about finished. It was an interesting experience and opened up a number of new viewpoints.

I have just been informed that I have been re-elected President of the American Chemical Society for another year and maybe I will have a second opportunity to come to Jersey, although from the number of invitations that have come in from the West and South it will be necessary for me to visit in those directions.

My own research work is going along steadily, and in addition I am assembling the material for a Life of Thomas Cooper--another early American chemical worthy.

With best wishes for continued success to the "Chemical Age" and for a very Happy New Year to yourself and your associates, I am

Faithfully yours,
Edgar F. Smith

To
MR. LLOYD LAMBORN, Editor
Chemical Age
New York

The cornerstone of the system of organization that we have submitted to the chemically educated men of America, and which has been studied and pronounced good, does not duplicate, conflict or compete with existing organization of recognized functions. Representations to the contrary arise either from baseless fear that it may or from a conviction that a single scientific organization sufficiently can satisfy the instinct of segregation of the vast number who make their living in applied chemistry. Which conviction, it is patent to all, partakes of the character of a delusion in the face of numerous organizations of chemically educated men called into existence by the increasing specialization of chemical vocations.

We put men above methods and submit that experience in the work of organization shall be the opportunity of the humblest, with the condition only that he have ambition which is the reflection of capacity. The young chemically trained man is handicapped at the start of his career by the lack of an instrument of self-development in which he can participate to supply the deficiencies of his academic education.

The state chemical society by its democratic structure provides this opportunity and makes possible at once (1) an effective means of popular education in chemistry the like of which does not exist, (2) an instrument for the promotion of chemical enterprise within the state and (3) the seed-bed for the propagation of the state professional society of chemists.

We would not disparage existing organization among chemists. We would commend its special service, but likewise would magnify the disparity between its purpose and the thinly marked and mainly neglected opportunities to develop the potentialities of chemically educated men. We have stated that making good in an industrial plant is not all that society rightly shall expect of its educated members; that with the increasing rate of accession of this type of men to the ranks of industry, opportunity must be provided to facilitate their absorption with that progressive minimum of waste inseparable from stable growth.

Existing organization within a state should be shaped to the end stated and where for any reason such adaptation is not deemed practicable, explanation is in order. Wherever this explanation puts maintenance of existing system above the organized study of the welfare of its supporters, change will be most fruitful. We need in this country intensive development of chemical interest expressed in a practical way in local familiarity with the problems and possibilities of chemical industries and their raw materials, human and inanimate, and to bring home to people the realization that chemical science in truth has made this era the Chemical Age.

The easiest way usually is the weakest way. Providing fillers for newspapers is an ineffective substitute for that intensive organization of chemical interest along state lines, whereby all identified with chemical industry may develop a sense of solidarity and thereby become the most effective instrument for popular education in the importance of chemistry and for the alignment of chemical enterprise within the state with its other organized activities.

There is that segregation which compacts and excludes and there is that which expands and embraces. In the latter type will chemically educated men find the fullest opportunity of self-development and of progress for the industry.

Improved Process of Margarin Manufacture

By William T. Ashby

MY aim has been to provide an improved process whereby a superior quality of oleomargarin may be produced with a saving of milk, whey or other flavoring medium and salt, and with a saving of labor and expense by simplifying the operation and reducing the space required for carrying it out; to produce an emulsion of the fatty and aqueous ingredients which is stable at the emulsifying temperature and in fluid form, thus to avoid the crystallizing heretofore required; to enable the ingredients to be used in the proportions in which they are desired in the finished product, and thus avoid working to remove the surplus; to enable the mixture to be tempered in a homogeneous state, preferably as a fluid, and to enable the mixture to be packaged in fluid form.

Procedure of Operation

In carrying out my process, covered by U. S. Letters Patent No. 1,400,341, the method of procedure may be varied somewhat according to the desires of the manufacturer and the materials and to the quantity and quality thereof which are used in the production of oleomargarin. In one course of procedure I first prepare the milk, whey or other suitable flavoring material to be used into a working condition in the usual way, after which I mix the fats or oils which are to be used, *e. g.*, cocoanut oil, oleo oil, neutral lard, etc., and bring them to the desired working temperature which will vary according to the results desired and the proportions of the different oils or fats used by a conventional method.

Any suitable proportions may be used, *e. g.*, 80 per cent of fats or oils and 20 per cent flavoring medium. The flavoring medium and the fats or oils are then mixed and the necessary quantity of salt added. The mixture is then passed into any one of the conventional types of emulsifying machines or so-called homogenizers, such as the centrifugal machine or the pressure machine, where the ingredients are broken up into an infinite number of minute globules held in suspension which are intimately mixed and the flavoring medium thoroughly distributed throughout the mixture.

The mixture is then passed into a holding receptacle where the "conditioning" or "tempering" takes place under suitable temperatures varying from 65° to 70° F. for a period of time varying from 18 to 36 hours according to the kinds of fats and the proportions used, the mixture being retained in the holding receptacle until the desired flavor has developed. The tempering of the mixture is begun with the mixture in a liquid or semi-liquid state, and is continued until the mixture has developed the desired flavor and consistency. From the holding receptacle the product is then transferred to a suitable filling device from which it is placed in suitable packages, when the product is ready for shipping.

As a specific example of my process of preparing oleomargarin in which I use cocoanut oil and milk in a proportion of substantially 80 per cent of cocoanut oil and 20 per cent of milk, I first pasteurize the milk at any temperature sufficient for pasteurization and then cool the same to approximately 68° F., adding 1 per cent of lactic acid culture. The milk is then thoroughly stirred and allowed to stand until the desired acidity has developed, which is approximately 0.7 per cent.

I then prepare the cocoanut oil and bring it to a temperature slightly above its melting point, and combine the cocoanut oil with the milk in a receptacle wherein the mixture is thoroughly stirred. After stirring, the mixture is passed through the emulsifying machine, the outlet of which is connected with a closed vat to receive the mixture as it passes through the machine. The mixture is allowed to stand in this vat for about 24 hours at a temperature of about 70° F. Then the desired quantity of salt is added and the mixture agitated to effect thorough admixture of the salt after which the product is ready for packaging and marketing.

In some instances I may omit the addition of the salt to the mixture until it has been passed through the emulsifier and then add the salt, subsequently agitating the mixture to thoroughly distribute the salt, and then package the product. I also have found that it is sometimes preferable to mix the salt with either the flavoring medium or fat before they are mixed, and then pass the flavoring medium and fats into the emulsifier separately where the mixing of the flavoring medium and fat takes place. Where, as above stated, the flavoring medium and fat are passed into the emulsifier separately, I may omit the salt until after the mixture of the fat and flavoring medium is completed in the emulsifier and add the salt after the mixture has been removed from the emulsifier. The addition of the salt at these different times depends upon the particular quality of oleomargarin desired, and in some cases the salt may be omitted altogether.

It also is possible to condition or temper the oleomargarin in the packages, thus eliminating the use of the holding receptacle, and where this procedure is followed the packages after receiving the oleomargarin are stored for the required time and at the necessary temperature until the desired flavor has developed.

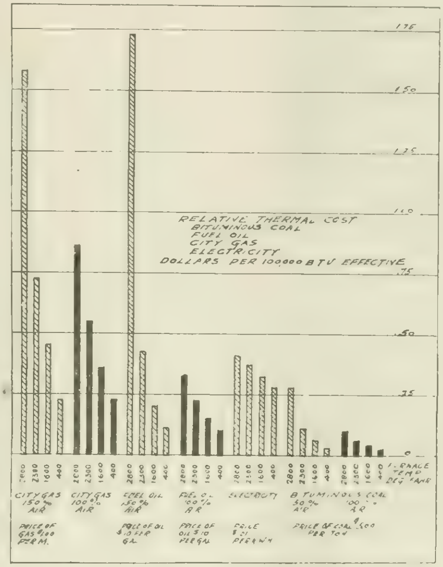
By the use of my process less flavoring medium and salt are required and superior and more constant results are obtained than by the use of the present known processes; also the cost of manufacture is reduced. These results are secured because I obtain an emulsion which is stable, as stated, and therefore does not have to be crystallized. It can be tempered without any change of form at all, if desired, and in any event in a homogeneous state, preferably as a fluid. This not only insures perfect distribution of the flavoring, but also enables the same to be conserved, in that the milk and the salt can be used in the proportions in which they are desired in the product. Furthermore, the mixture in a fluid state can be handled to great advantage and, if desired, can be run in that form into molds or packages and solidified there.

Electric Heat for Thermal Processes

By E. F. Collins

Industrial Heating Engineer, General Electric Co.

THE progress of electricity in furnishing heat for industry has been such, over the past decade, that in the near future its application to important thermal processes will be as much a matter of course as its use for lighting is today, and for substantially the same reasons. It has been proved that, when over-all charges of production are figured, electric heat is the most economical form although its cost in dollars per BTU utilized in baking ovens, furnaces, etc., is considerably higher than that of any other fuel. It has demonstrated its superiority to both gas or oil from the standpoint of maximum safety, uniformity of finished product and economy of operation.



The three basic features that combine to make electric heat produce these results are those of heat generation, transmission or delivery to the charge, and conservation. In addition to these and supplementing them are the flexibility and accurate control possible, the cleanliness of the surroundings and the speed of operation. It is for these reasons that the finished products can show an improved economy in charges that more than make up for the initial expense, both for apparatus and for operation.

In the electric oven, or furnace, heat generation can be kept almost perfectly balanced against heat absorption by the charge. Since the ultimate efficiency of the furnace rests upon the ratio of heat generated to that absorbed, the importance of this factor cannot be overestimated. All BTU's that are not absorbed by the charge are simply wasted, no matter how efficient the source of heat, or how carefully it is tended. In the electric furnace this is taken entirely out of the hands of the operator, and is removed from the influences of fuel, air supply and so forth.

The reason lies largely in the methods of heat transmission in the different furnaces. These may be divided into three classes, viz., convection in liquids or gases, conduction in liquids or solids, and radiation through space or the ether. Heat may be likened to a liquid, such as water, tending to flow from a higher head, or potential to a lower, the flow being in proportion to the resistences in the channel, so to speak. In the fuel furnace, the ordinary methods are either by convection or conduction, and in the electric it is usually by radiation.

In transmitting heat by convection, factors enter that are very apt to interfere with the even distribution of heat and with its complete utilization. For instance, in the fuel fired furnaces forced draught is usually employed, which tends to give the gases a cyclonic velocity and erratic travel, making complete and properly regulated envelopment of the charge a difficult matter.

Convected heat is deposited on the surface of the charge being heated and penetrates that charge by thermal conduction. Hence the rapidity of heating and its completeness are dependent entirely on the degree to which the charge is enveloped and the speed at which the gases pass it. Radiant heat, such as may be employed exclusively in the electric furnace or oven, has a penetrating characteristic that enables it to pass directly into the charge without being first deposited on the outside and working its way in. This results not only in more rapid heating, but in a more complete or better penetration of the heat throughout the charge, without excessive surface heating.

The greater conservation possible with electric heat is due to a combination of the above features, with others. Among the latter are the atmospheric conditions inside the furnace and the difference in the insulation characteristics of fuel and electrically heated units. With electric heat the charge may be heated in any sort of atmosphere derived, from a vacuum to high pressure. Partly owing to the absolute control of the conditions inside the furnace and partly to the character of the heat itself, all the heat generated is utilized in heating the charge, none being wasted by being carried up the flue or otherwise.

The insulation of the heat in the electric furnace becomes important when it is realized that with good heat insulation and perfect conversation, the standby loss of the electric furnace becomes a fixed minimum for any temperature, and consequently corresponds to a definite input of electric power independent of external conditions. Due, however, to the variable combustion efficiency of the fuel-fired furnace, uniform performance and thermal efficiency are at the mercy of operator, fuel and air supply.

In the past few years since its inception, electric heat has been applied successfully to an ever increasing number of industrial processes, requiring equipment ranging in size from small individual cartridge units for local heating, to furnaces capable of melting tons of metal at a heat. Almost every industry that makes use of thermal processes has been invaded by electric heat in one form or another, with uniform results as far as improved economy in operation and increased efficiency in production [illegible] examples is the best way to point out the advantageous character of these devices.

One of the fields where the electric oven has amply demonstrated its superiority is in baking cores, of which exist numerous examples of successful installations. In the furnace field, an application that was only perfected after much study and experimenting, is that of baking vitreous enamel on various objects. The results obtained from furnaces engaged in this work have, however, more than justified the trouble that was taken to develop them. The operating temperature of the furnace shown in Fig. 1 is 1700° F. and the connected load 140 k.w., at 220 volts, 3 phase, 60 cycles. Heat is automatically controlled, and the results in comparison with the coal furnace previously operated on the same work are very satisfactory. The outstanding features of the new furnace are the extreme speed with which it can be heated up and operated, the cleanliness and improved appearance of the surroundings and the absence of rejections in the finished product. Heats that took three minutes 40 seconds with the coal furnace have been completed in one minute 50 seconds by the electric.

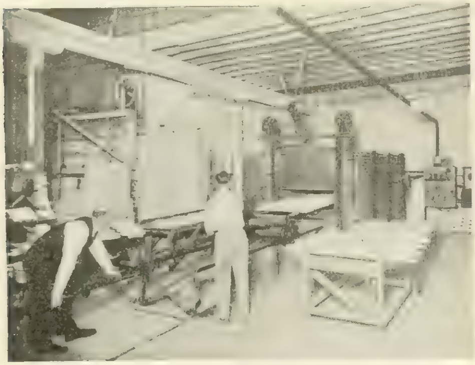


Fig. 1. Electrically-heated Vitreous Enamel Furnace. Dimensions: 10 x 4 x 2 feet high.

Fig. 2. [illegible]

One of the latest developments in electric heating is that of annealing glass of all sorts to reduce the internal strains incident to its cooling. Here the electric lehr has established itself through its perfect temperature control over a wide range of steps and long period of time, the cleanliness of the atmosphere inside the heating chamber and its ability to duplicate results time after time. These lehrs are now being used to anneal a number of different kinds of glass, from delicate X-Ray tubes, Fig. 2, to enormous telescope lenses, and with unvaryingly successful results.

These few instances are enough to show the practically unlimited scope of electric heat, when properly engineered. That it will eventually replace the other forms in a good many instances, where its advantages are most pronounced is no longer a matter of conjecture, merely of time. Its applications to new processes occur with such frequency that it behooves the user of heat to canvass thoroughly the possibilities of electric heat before either revamping existing installations, or adding new thermal process equipment that employs fuel-fired heating.

Du Pont Chemical Fellowships

E. I. du Pont de Nemours & Co. has authorized the continuance of Du Pont chemical fellowships in twenty colleges and universities throughout the United States for the scholastic year of 1922-1923. The total value of these is $15,000. The fellowships are for postgraduate work and are placed in the institutions which have well established postgraduate courses. The recipients are to be selected not by the Company, but by the university authorities, the only condition made by the Company being that the awards shall go to graduates who devote the major part of their time to the study of chemistry.

The object of the plan is to promote the study of chemistry and to assist deserving students, who have shown especial aptitude for chemistry, to pursue further work. This differs from the usual plan for industrial fellowships in that the Company does not insist on the student carrying out an investigation on subjects in which the Company is interested, but leaves him free, under the direction of his instructors, to follow whatever line of investigation seems to him most promising. The institutions which receive these fellowships are:

Brown University, Providence, R. I.
California Institute of Technology, Pasadena, Cal.
University of California, Berkeley, Cal.
University of Chicago, Chicago, Ill.
Columbia University, New York, N. Y.
Cornell University, Ithaca, N. Y.
Delaware University, Newark, Del.
Harvard University, Cambridge, Mass.
University of Illinois, Urbana, Ill.
Johns Hopkins University, Baltimore, Md.
Lafayette College, Easton, Pa.
Massachusetts Institute of Technology, Boston, Mass.
University of Michigan, Ann Arbor, Mich.
University of Minnesota, Minneapolis, Minn.
Ohio State University, Columbus, Ohio.
Princeton University, Princeton, N. J.
University of Virginia, University, Va.
University of Washington, Seattle, Wash.
University of Wisconsin, Madison, Wis.
Yale University, New Haven, Conn.

For the past four years chemical scholarships have been established in American institutions by the Du Pont Company to encourage the development of the first requirement of a native chemical industry, viz., large numbers of research chemists.

Some Phases of Chemical Cost Accounting. II.

C. B. E. Rosén, M.B.A., C.P.A.
Charles F. Rittenhouse & Co., Boston, Mass.

OWING to the large capital investment in a chemical plant some consideration has been given to a plan for the distribution of manufacturing overhead on the basis of the investment in the buildings and equipment in each department. This method raises questions regarding the idle plant and the use of cost or depreciated capital values. For some companies this method may be more equitable than any other.

Idle Plant

In a chemical concern maximum earnings require capacity production. This is difficult to maintain due to frequent breakdowns, seasonal products, weather conditions, market conditions and the concentration at times on the production of profitable products, at the expense of the unprofitable ones.

In any system of cost accounting it is highly desirable to show in the accounts the unabsorbed burden, which avoids the inflation of inventories. The many different processes and conditions existing in a chemical plant would make a budgetary control of production and overhead impracticable, since it can not be estimated in advance what the ratio of overhead to each unit produced should be.

However, a close approximate cost of idleness or unabsorbed burden in the various departments can be ascertained. In order to do this, daily records are kept of the idle departments which are summarized at the end of each month. As a practical matter, it is advisable to set a minimum number of idle days, five for example, below which no account will be taken in figuring idle plant. These may or may not include Sundays and holidays depending on whether the process is operated continuously or not.

At the end of the month, the same proportion of those manufacturing expenses which remain constant whether the plant is operating or idle, which the actual number of idle working days in the month bears to the normal number of working days in the month, represents a loss from idle plant.

Occasion may arise when a department uses a small amount of labor during a month with a consequent charge for works expense, and yet in such a case there may be no production during that month. The purpose of such labor would generally be to improve the product for the market. As such it is charged (labor and works expense) into finished goods, and the other overhead expense is charged to loss from idle plant. The proper treatment in the cost and general accounts of the loss from idle plant depends upon the cause of the idleness. It may represent a proper charge against production, a selling expense, or a direct charge to the profit and loss account.

Detailed Overhead Expense Reports

As further information for the factory management in regard to the items which enter into the manufacturing overhead expenses, are monthly reports of these overhead expenses. These reports can be prepared easily in columnar form so as to show monthly comparisons. By stating therein the principal charges to each of the expense accounts, the reasons for fluctuations can be investigated readily and immediate steps can be taken to eliminate unnecessary burden.

Cost in Bulk

When the manufacturing cost figures have been accumulated to the point that shows the manufacturing cost in bulk, it is divided by the units produced, the result being the unit cost for the month.

It is advisable to show the manufacturing costs on the cost department's reports in terms of the commercial strength as well as the standard strength, where those strengths differ.

Comparison of this figure for different months may show questionable discrepancies which may be accounted for by the "yield," or by errors in the reports of production or of raw materials used.

By yield is meant the average volume of production which should be obtained from a certain quantity of raw materials consumed. The skilled chemists can supply this information to the cost accounting department and from these data the percentage of efficiency can be ascertained and shown on the cost sheets.

The competent cost accountant must read his reports very critically in order to present clear statements with concise comments regarding the fluctuations in costs.

With a few exceptions no account is kept of goods in process, because there are but few products which might be in process at the end of the month and which can be separated. Theoretically, there is a portion of each chemical in process at the end of every month, but this is overlapping and cannot be arrived at readily. When the product is completed it is either sold or used in another process in the same plant.

It should be emphasized that the elimination of the goods in process account is not at all general in other industries.

Production Reports

The works accounting department supplies the cost department with the quantities produced monthly. There are some processes in which the product is constantly being used as produced, thus making it very difficult, if not impossible, to ascertain directly the quantities produced.

Under such conditions productions are determined by deduction. The stock on hand at the beginning of the month is known, and by measuring the tanks, in the case of liquids, or by weighing or estimating, in the case of solids, the stock on hand at the end of the month can be ascertained. From the shipping department the sales can be obtained and from the receiving department the purchases, if any. The closing inventory plus sales, less the opening inventory plus purchases gives the production, after taking into consideration any necessary adjustments.

The production thus arrived should reconcile with the quantities reported as received in the departments which use the product. Any differences, which often occur due to evaporation, leakages, and similar conditions, are either absorbed by the departments using the

---

The importance of accurate and uniform methods of [illegible] in chemical manufacture has induced the National Association of Cost Accountants, 130 W. 42d St., New York, to publish in Vol. VII, No. 6, of its official publications, Mr. Rosén's study [illegible] upon which the present article is adapted, the initial part of which appeared in December, 1921, Chemical Age product, or if the discrepancy is abnormally large, are charged off to profit and loss. The production of a certain chemical may involve the production of two or more distinct elements in the final product. Information regarding quantities produced and the manufacturing cost of each element in such a group is often of great value. Therefore in accounting for the cost of such a product, it is treated in the accounts as two or more distinct products, and later the cost of each product is combined.

Finished Goods Purchased

At times it is necessary to purchase from outsiders goods which are produced by the plant in order to meet the demands of the trade as well as the requirements of other products which use such finished product as a raw material in their process. Such purchases must be kept separate in the accounts so that the costs of the same product produced at the plant shall not be affected, (generally increased), and so that the earnings on such transactions may be ascertained separately.

These purchases are handled in accordance with the same principle as raw materials are, as already explained. In charging out these purchased goods to manufacturing costs, it is desirable to use the cost of production of the similar product within the plant, and then to show the excess, that is the difference between the production and the invoice costs, as a separate charge for raw materials to the department in which they are used.

Transfers of Finished Products

Inter-departmental transfers of finished products should be made at cost without any element of profit. The cost to be used may differ. Where a product is pumped, as produced, direct into another process, as a raw material, the use of the current month's manufacturing cost in bulk is justifiable, whereas in case a product is produced and stored away in stock and is drawn on from stock for use in other departments, the average stock cost of the product so transferred is used.

Many of the departments are dependent upon one or more of the other departments. This inter-department relationship makes it necessary to start each month's costs by using the average cost of the opening inventory, for that month, of that finished product which is the basic element used in manufacturing the plant's most representative product. When the inter-departmental transfers have thus been started, the other products can readily be costed for the month.

Selling Cost of——————
Month of————192————

	Quantity Sold	Amount	Per Unit of Measure
Manufacturing Cost of Net Sales in Bulk		$....	....
Grinding Costs		....	....
Packing Costs		....	....
Total Factory Cost Prepared for Shipment		$....	....
Selling and Administrative Overhead:	$....		
Selling and Shipping Expenses	....	....	....
Administrative Expenses	....	....	....
		....	....
Total Selling Cost		$....	....
Gross Sales		$....	..
Less:			
Returns and Allowances	$ (*enter in red*)		
Freight Out		....	....
Net Sales			...
Deduct:..			
Total Factory Cost Prepared for Shipment		....	....
Gross Profit		$..	
Deduct:			
Selling and Administrative Overhead			
Net Trading Profit		$..	

Cost of Packing and Preparing Products for Shipment

The labor and consequent overhead involved in packing and preparing certain products for shipment is not separable from the manufacturing labor, in all cases, as the same labor that attends to the manufacturing process attends to the packing of the product. However, in such cases the cost of the containers used can readily be ascertained.

On the other hand, the packing of some products involves a separate process, such as grinding, which is accounted for through separate manufacturing accounts. Earlier in this article consideration was given to the item of containers as it affects the cost of raw materials. The relation of containers to the cost of finished goods prepared for shipment will now be discussed.

The cost of containers used must be considered from two viewpoints, viz., non-returnable and returnable containers. Non-returnable containers such as slack barrels, small kegs, boxes and cartons are purchased in large quantities and are kept in separate accounts both as to quantities and values. As they are used, they are charged out at average stock costs. The problem of returnable containers is a more difficult one. Space will not permit of a complete discussion of this problem.

The most important of the returnable containers used in a chemical concern are carboys, tight barrels and drums. A chemical concern generally maintains separate departments for making and repairing carboys, tight barrels, and drums. Separate accounts are kept showing the total costs of operating these departments. In order to separate the maintenance charges from the cost of making new containers in these departments, records must be kept of parts on hand, received and used, and the number of new containers or container parts made. The capitalizable portions of these accounts are separated on the conservative basis of the average quantity of materials used in the manufacture of the containers and at their average cost. This average basis is adopted because it is practical and does not fluctuate. The balance of the account represents maintenance charges which are absorbed.

In addition to the cost of maintaining returnable containers, there is the element of depreciation. The depreciation of each type of returnable container is figured on the estimated life, and the average number of trips which the returnable container will make, after allowing for the estimated salvage value, if any. The amount of depreciation thus arrived at is used uniformly as an element of the cost of packing. No distinction is made between the containers packed and the containers shipped, as for practical purposes they are the same, because the containers are generally always packed only as required for shipment.

The container cost, for goods shipped in containers which the customer has the privilege of returning, consists, therefore, of maintenance and depreciation. The maintenance charge for each type of returnable container are distributed on the basis of the number of such containers shipped each month. Likewise the depreciation charge for each container shipped is charged to the various products and credited to the reserve for depreciation of each type of returnable container. Any losses of materials sustained in packing are absorbed in the packing cost.

There are two groups of accounts kept for containers in the general accounts. One group of accounts represents an asset and is kept under the title of Packages—subdivided by types, at the cost price of containers purchased or made, which are to be used as returnable containers. This account is credited with the cost of such packages when sold or destroyed. Another group of accounts represents a liability and is kept under the title of liability for the Redemption of Containers in Customers' Hands. The liability is to the customers for returnable packages charged to them and in their possession which they have the privilege of returning, if not damaged, at the same value at which they were originally charged to the customers.

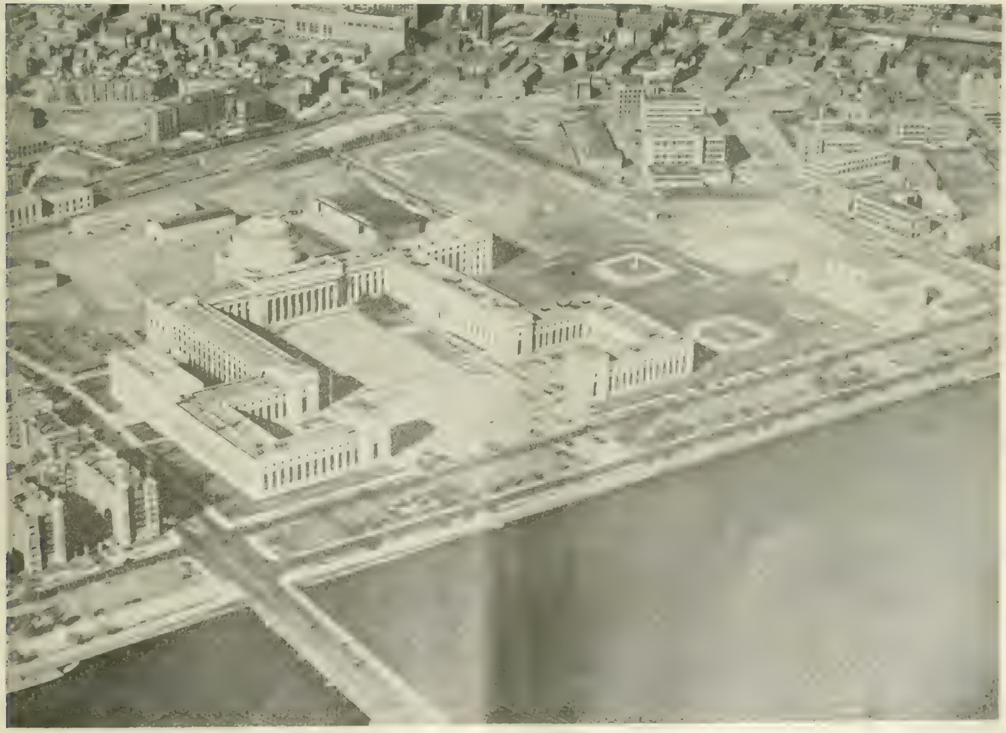
Selling Cost by Products

The selling and administrative overhead and its proper distribution must be given careful consideration. It includes the cost of maintaining the selling, shipping and administrative departments. In distributing this overhead to the various products, several bases are advisable. The selling and shipping expenses are distributed in various ways such as on the basis of the quantities shipped, or on the basis of the cost of sales, or they may be charged directly to the product.

The basis of distribution cannot be fixed for each case. It must be made in the most equitable way after giving careful consideration to the facts peculiar to each case. Unless monthly selling costs by products are desired, the results are of a more practical value if this distribution is made quarterly or semi-annually, because the selling and administrative overhead may fluctuate widely from month to month. The selling cost data thus obtained, together with the manufacturing cost in bulk of each of the products referred to above should then be combined in report form by the cost department.

A pro-forma selling cost report, which also reflects the gross profits from sales, is shown on page —. This form of report is arranged so as to set forth, primarily, the total selling cost. If desired, it may be followed with a condensed Trading Profit and Loss Statement for each product, which also may be provided with percentage ratios.

Aeroplane View of Mass. Institute of Technology



Courtesy Captain [illegible] Kodak Company

Chemical Warfare

THE resolutions adopted unanimously by the American Institute of Chemical Engineers at its Baltimore meeting Dec. 6, 1921 demanding that the use of chemicals in warfare be continued and that there be such preparations as will enable the United States to manufacture poison gases in large quanties in time of war, are in notable conflict with the judgment of Dr. Ira Remsen and with the report of the advisory committee to the American delegation at the limitation of armament conference, drawn by General Pershing. In this connectiton the broad viewpoint of *The Financial Chronicle* is of interest, which says:

It is "very strange" that a national society of chemical engineers defends further experimentation in the production of poison gas on the ground that there are elements of the humane in this process of overcoming an enemy by wholesale killing. It may be a more painless death to die by asphyxiation than by being blown to pieces by a bomb, but in war it can hardly be argued that the number of deaths will be diminished by sending waves of deadly gas over a whole army.

We read that this art of murder has already been so perfected that liquefied gases can now be produced one drop of which touching the skin will surely kill. Deadly gases, we are told, can be produced that no mask can withstand—that will wither the trees and grass, make sterile the soil, burrow into trenches, spread desolation and decay, with death over wide areas.

It is argued that Science must not sit still in the face of what others may do in secret. Never, we think, had the Black Magic of the Middle Ages more strenuous defenders than these advocates of further experimentation in the making of malevolent compounds in the alleged fear of what others may do!

The Attainments of Science To What End?

And yet we are talking and working for peace. We talk of reconstruction of "devastated areas." We talk of the rehabilitation of peoples, of the resumption of trade, of reparations in terms of money. Good-will, like an invisible courier of hope and help, we would speed across the whole earth. We have conquered the air, and enthusiasts predict a commercial development in this form of transportation that will transform commerce, binding the world into unity. We are proud of our progress in the varied use of electricity in light, heat and motion. Waterpower will save us fuel. Study of soils will increase our acre production. We shall soon listen over unnumbered miles of territory to the music of the opera. Talking-pictures are a little way off, it is asserted. Synthetic precious stones "that only an expert can tell from the natural" are already on sale. It is hinted that exploration verges upon the transmutation of metals.

What Science may do to increase comfort and happiness and reduce the need for hard labor, they now tell us, is beyond the imagination. And yet it would not be altogether well to turn from death to life, for fear that others, secretly, may manufacture new possibilities for death!

Science and Warfare

We do not severely criticise the attitude that demands further experiments in death-dealing. It is seen by its advocates as a means of prevention, of preparedness. And it is a logical sequence to a form of loyalty that is not wholly to be condemned. But if we are ever to dismantle war, and hurl it into hell, what must be said of this thing itself? Only that it is, in itself, impious blasphemy, a mockery of the beneficent laws which enfold us, and a taunt to God who gave to man "dominion."

And if we recall the belief of Tolstoy that wars will never cease while Governments have power to make war—that wars will never cease until man himself refuses to kill his fellowman, man the individual responsible to the God who made him, then, we cannot avoid the conclusion that upon Science must rest the responsibility of feeding the agencies that war uses.

Discarded Fallacies

In the same breath these adepts in chemistry condemn war utterly. And so now does every thinking man. Gone is the specious claim that it leads to physical development, to courage in life, to character that knows and respects duty, to discipline that determines the effectiveness of service. Gone is the old idea that the very deadliness of the instruments of war will tend to prevent war. No one seriously brings up these arguments now. We know that neither is tenable. But how long will it be before we reach the heights of that abnegation which refuses to recognize war as a legitimate part of human existence to the extent that suffering is sometimes the better part of valor, and that to each man is given one life to keep—and to keep in such a way that neither through knowledge nor spirit it shall interfere with the life of another?

Diversity of Opinion

It is inevitable that some discordance creep into our deliberations. We are not of one mind. But at the very moment when a conference is seeking to diminish and limit present known armaments, it is meet that we read in this declaration of scientists the true meaning of the spirit of ultimate peace. And it can only be that abandonment of all thought of future war is our salvation.

By *we*, we mean humanity; by abandonment we mean a turning away of all experiment by all peoples and their scientists from destructive process to constructive.

Chemical Warfare Research

We have no key to a human soul. We pass no judgment on the conscientious study of any individual. But we wonder what can be the thought of one learned in the mysteries of science as he delves in his laboratory seeking for compounds that may be used in war. Is this an example of patriotism?

We think it may be. For it is defense not offense, at least with us now at peace with all the world, these investigators have in mind. But even so we are taught the lesson that it is the spirit that shall alone bring us out of the dangers of possible wars.

Roger Bacon, it is now contended, wrote many of his discoveries down in cipher, fearing not alone for his own life, but fearing for their use by ignorance in the then state of learning. Must not every people, every profession, every class and individual, so fear in this age the use, the possible future use, of all implements of war, by passion and hate, by those who have not yet been delivered in spirit from the thraldom of militarism?

Until the universal conscience is quickened to utter condemnation, to absolute abandonment, those who love peace must preach in season and out the unceasing consecration of the spirit to processes in the physical world that tend to peace and away from war.

Sigma Xi

A Society for the Promotion of Scientific Research.

CONTRARY to a prevailing impression, naturally arising from its Greek letter title and the absence of publicity, outside of a limited circle, in connection with its personnel and activities, Sigma Xi disclaims any pretense to secret organization or to have the character of a professional society. Established at Cornell University in 1886 for the express purpose of fostering the spirit of research in American educational institutions, for the first twenty or twenty-five years of its existence it did so by honoring with election to membership those undergraduates in the scienific and engineering courses of study who had ability along the lines of independent investigation.

Qualifications for Membership

As the organization spread among the universities, it came to be the practice of the various chapters to elect to full membership only those students who had actually accomplished a piece of research work in scientific or engineering lines. Other students who had given promise of ability, but who had not actually performed any research work, were elected to associate membership. The difference between the two kinds of members is indicated by the society insignia which each is allowed to wear, the full members wearing the Sigma Xi key and the associate members a small bar pin with Sigma Xi letters. Furthermore, only full members have the right to participate in elections.

Sigma Xi is not to be confused with the Greek letter fraternities of the academic world or the usual secret orders to which men belong. Its constitution, its purposes, its meetings, and everything about it are public. The only prerequisite to membership is that the individual shall have shown promise of ability in research along some line or shall have actually accomplished results in research.

It is notable that most of the research men and women on the staffs of research laboratories either in industries or universities are members of Sigma Xi. The leading men connected with the government's scientific departments, such as the Bureau of Standards, are Sigma Xi men. It is quite natural that those whose work in college and university has merited election to Sigma Xi will continue research work as a life career.

The largest proportion of Sigma Xi members go into some technical pursuit, as engineering in its various branches, physics, chemistry, biology, etc. A smaller portion go into medicine, and a still smaller into law and administrative positions.

Expansion

Up to the last convention held Dec. 27, 1921 at Toronto, Canada, in connection with the meeting of the American Association for the Advancement of Science, there were thirty-three chapters, including most of the prominent universities in this country. The total membership has grown to something like thirteen thousand. At the last convention it was voted to grant charters to the University of Idaho, to Rutgers College, and to McGill University in Canada.

The Rutgers College charter means a revival of one of the early chapters, a charter having been granted to that college in the first or second year of the society's existence. For some reason or other it did not function for many years. With the expansion of the work of this institution, and because of the research work being done there, especially in connection with its department of agriculture, the society thought the time had come for a revival of the original charter.

The granting of a chapter to McGill represents the modern policy of the society which has come gradually to fruition, viz., expansion into an international organization. The Executive Committee of the society has for the last half-dozen years been in receipt of inquiries regarding requirements for the establishing of new chapters not only from institutions in Canada, but from similar institutions in Europe.

These inquiries were so spontaneous that the Executive Committee felt the time rapidly was approaching when the society which had been originally established to promote the spirit of research in the United States should extend its influence to institutions in other countries. The chapter at McGill will, when installed, be the first chapter of Sigma Xi outside the borders of this country, and it is believed that it represents the beginning of an enlarged activity on the part of the society.

The society already is considering requests for charters from some eight educational institutions in this country. The particular quality which the society seeks in all inquiring institutions has regard to the facilities for research which the institution affords. A personal inspection by some official of the society is required before any definite consideration of an application for a charter.

Research Fellowships

Another illustration of expanded activity in the promotion of research on the part of the society is afforded by the establishment of research fellowships. Some five or six years ago Professor Stieglitz, of Chicago, suggested that in addition to the many ways in which the society has been promoting research, it might actually undertake to support research work financially. It took several years to get the plan in operation. During 1921 some thirteen hundred alumni members of the society pledged themselves to give an annual contribution of two dollars each for fellowship purposes. In October of last year, the first Sigma Xi Fellowship was awarded to Dr. Alexander Weinstein of New York on this foundation. He is at work in the laboratory of Professor Morgan of Columbia on certain genetic problems on which he has been at work for five years or more, and regarding which he has issued publications.

The Fellowship Committee of Sigma Xi works in close cooperation with the Fellowship Board of the National Research Council, and for the present will grant awards to workers in fields other than physics and chemistry, which fields are so thoroughly covered by the Council. Otherwise, Sigma Xi places no limitation on the field of work in which it is ready to grant fellowships. The whole purpose of the society is expressed in the idea "The Promotion of Research." It does not purpose to limit itself to research in any one field. Its aim is to develop and foster and maintain the research spirit.

It is believed that the next five years will see the influence of Sigma Xi in scientific circles greatly extended and strengthened. It is expected during the coming year to reach three times the number of alumni members reached during the year just closed, and instead of one fellowship or two, it is hoped that the society may be able during the coming year to award at least three, and perhaps four.

The Fellowship Committee confers constantly with a similar committee of the National Research Council; in fact, the latter Board has been requested to appoint one of its members as an ex-officio member of our committee.

Administration

The officers of Sigma Xi elected at the recent ocnvention are: Professor Henry B. Ward, University of Illinois, President; Dean Edward Ellery, Union College, Secretary; Dean George B. Pegram, Columbia University, Treasurer. The Executive Committee comprises Professor Floyd K. Richtmyer, Cornell Univerity; Professor Carl H. Eigenmann, University of Indiana; Professor Lauder W. Jones, Princeton University; Professor George W. Stewart, University of Iowa; Professor Clarence E. McClung, University of Pennsylvania. The business of the society is conducted by the Executive Committee in conference with the officers. The Committee meets twice a year: once in connection with the annual convention which is always held under the auspices of the Association for the Advancement of Science; and once in the spring of the year. The expenses of the spring meeting are borne by the society, and in recent years all the members of the Executive Committee and all the officers have been present at both meetings. This means that the officers of the society are giving to its affairs of the society the serious consideration which the expanding importance of its work demands.

After a service of 27 years as secretary of the society, during which period he contributed much to its development, Prof. Henry B. Ward, University of Illinois, was elected president at the recent Toronto meeting and was succeeded as secretary by Dr. Edward Ellery, Professor of Chemistry and Dean of Union College. Dr. Ellery is chairman of the Fellowship Committee to whom all applications for fellowships for the coming academic year should be made not later than March 31.

The Bacteriology of Sauer Kraut and Pickles

By Dr. Edwin Le Fevre
Chemist, Microbiological Laboratory, Bureau of Chemistry,
U. S. Department of Agriculture.

THE fermentation industries are large consumers of agricultural products and are an important factor in the economy of many rural communities. The manufacturing procedure, empirical in its origin as a household art, has come to require, especially with the more progressive concerns, a high order of scientific supervision. Inasmuch as undesirable fermentation and spoilage have their influence in increased cost of the finished products the technically trained man, possessing specialized qualifications of the chemist and the bacteriologist, has ample opportunity to demonstrate his value in industries concerned with the fermentation of brined vegetables*.

Cultural tests have shown that cucumbers and cabbage as they come from the field are heavily seeded with micro-organisms. In the case of cucumbers two methods of fermentation are commonly used. In a weak brine fermentation, such as is used in making dill pickles containing, as a rule, less than 5 per cent of salt at the start and this rapidly reduced by dilution, the lacto-bacilli multiply rapidly and the spoilage organisms are but slightly inhibited. In a strong brine fermentation, such as is used in curing salt pickles, containing usually about 10 per cent of salt at the start, this amount being gradually increased to about 15 per cent, all types of micro-organisms are greatly inhibited, even the lacto-bacilli decreasing rapidly in numbers after a period about ten days. Such a brine becomes practically sterile within a few weeks. This explains why spoilage takes place when pickles are held too long in a weak brine while in a strong brine they are preserved indefinitely.

The fermentation of cabbage is carried out in a weak brine formed by its own juice which is rapidly withdrawn by the action of salt. In this case spoilage is prevented by the greater acidity which usually is sufficient to prevent the growth of spoilage organisms.

The essential factor in all of these brine fermentations is a well-defined group of the lacto-bacilleae. This group is widely disseminated in nature and is always present on cucumbers and cabbage. The most favorable media for their growth are the vegetable juices, especially those of cucumbers and cabbage. The most favorable temperature is approximately 30° C. (86° F.). Their fermenting activity, as shown by our experiments, decreases in the same ration centigrade as the temperature falls below their optimum. This is a matter of great practical importance in the fermentation of both cucumbers and cabbage. It is especially important that the optimum temperature should prevail at the start of a fermentation. In the case of cucumbers the proper temperature readily can be secured by heating the water used in making the initial brine.

The use of pure cultures as starters in the fermentation of brined products have not been shown by our experiments to be of great practical value. These experiments have indicated, however, that the use of cultures of properly selected organisms may be of value in improving the flavor of these products.

Our experiments during the past year have confirmed those of previous years in showing that the addition of a readily fermentable form of sugar to a pickle brine results in a more active fermentation with a higher and more prolonged degree of acidity.

As a result of a series of investigations carried out during the seasons of 1920 and 1921 it was found that cucumbers infected with mosaic show great loss in curing. It was also shown by these investigations that the number of defective pickles found after curing correlated closely with the physical evidences of the disease shown by the cucumbers. When these evidences were marked roughly 70 per cent were defective after curing; when slight the defectives amounted to about 30 per cent. The investigation also suggested the possibility that, as a result of incipient mosaic, cucumbers which are apparently sound may show defects after curing due to that cause.

C. Bischoff & Co., Inc., 451-453 Washington St., New York, announce that beginning Jan. 1, 1922, they will continue the business under the name of Carbic Color & Chemical Co., Inc.

---

*[illegible] Jan. 16, 1921

Conversion of Petroleum Residuum Into Gasoline

The Address of Acceptance of Dr. William M. Burton, President, Standard Oil Co. of Indiana, on the Award of the Perkin Medal by the American Section of the Society of Chemical Industry, January 13, 1922, at Rumford Hall, for Distinguished Service in Applied Chemistry.

THE awarding of the Willard Gibbs Medal to me in 1918 would seem to be sufficient recognition on the part of American chemists of the industrial work that has been done under my direction; and now comes this additional honor and distinction. I appreciate in the highest degree the compliment this medal conveys, and I hasten to express my most sincere thanks to the members of the awarding committee and to the societies they represent.

The Problem

The work done under my direction, which has perhaps attracted the most attention was carried on principally in the laboratory and refinery of the Standard Oil Co., at Whiting, Ind., a suburb of Chicago, and consisted in devising ways and means for the practical conversion of high-boiling fractions of petroleum into low-boiling fractions in such a way as to insure substantial yields of suitable products with a minimum loss at a reasonable expense.

The problem became imperative with the advent of the internal combustion engine about fifteen years ago.

The most commonly known example of such an engine is, of course, the automobile, which, as constructed today, requires a fuel that evaporates at comparatively low temperatures, has a high heat value expressed in British thermal units, burns without leaving objectional residues, does not possess an objectionable odor, is low-priced and can be produced in large quantities. Benzol, toluol, and alcohol, are fairly well suited for the purpose, but their cost and their small volume of production render them largely unavailable.

The low-boiling fractions of petroleum naturally came into use for this purpose and up to about 1910 the supply of this fuel was sufficient to meet the demand. In fact, the automobile provided an outlet for the sale of these products which to some extent, had been a drug on the market in the oil world. The older refiners in the country will remember when these so-called "naptha products" were thrown away and allowed to run down the streams adjacent to the refineries, thereby causing a wilful waste and a fire menace to the surrounding neighborhood.

Prior to 1910 the average yield of naphtha or gasoline products from crude oil in the United States was about 11 per cent., this yield representing only the amount of such products (of the quality desired at that time) normally present in the crude petroleum, the separation of them being secured by ordinary methods of distillation at atmosphereic pressure; and, further, this small yield was sufficient to furnish all that was needed for gasoline stoves and other industrial purposes prior to the advent of the internal combustion engine for transportation purposes.

When the automobile came into general use, however, it was perfectly clear that the normal yield of naphtha products suitable for fuel in self-propelled vehicles would not be nearly enough. At that time our refiners were selling about 40 per cent. of the products of crude oil for use as fuel and for gas-making purposes in lieu of coal. The remaining 60 per cent. represented the normal yield of naphtha and gasoline, illuminating and lubricating oils.

The above mentioned 40 per cent. fuel and gas oil comprised fractions boiling between 225° C. and 375° C. These oils could, if necessary, be withdrawn from the market, and our problem was to convert them as far as possible into fractions boiling between 40° C. and 200° C., the products to be equal in quality to normal naphtha products, and the yield and operating expense to be commercially practicable.

Early Experiments

Our first experiments were directed toward making a suitable product by superheating the high-boiling vapors as such, but without pressure, somewhat along the practice observed in making pintsch gas. We soon found, however, that this so-called "cracking" in the vapor phase required a temperature so high that the aliphatic hydrocarbons contained in the petroleum were largely converted into cyclic and aromatic bodies and fixed gases—unsuited for our purpose. The yield was poor and the quality most undesirable. Obviously our problem included the proposition or reducing the molecular weight without changing the general structure.

We next tried the use of various reagents and catalyzers, such as aluminum chloride and ferric oxide. Anhydrous aluminum chloride, indeed, produced some rather remarkable results. The yield and quality of naphtha products were fairly satisfactory, but there was a substantial loss of oil in the operations and the first cost of the anhydrous aluminum chloride, as well as the difficulty in recovering it from the residues, rendered this plan unattractive.

Nearly thirty years ago Sir Boverton Redwood and Professor Dewar, in England, had patented a pressure distilling process for the purpose of increasing the yield of kerosene oil from the residues of Russian crude petroleum, but it never was applied industrially. It had been known, therefore, for some years that distilling petroleum under pressure served to break down the high-boiling fractions into low-boiling fractions but, as far as we could learn, no one had ever done it on the large scale, and, in fact, such a proposition could not commend itself to a practical refiner, because of the obvious dangers from explosions and fires that would be present in handling large stills under such conditions.

Large Scale Experimental Operations

But having tried everything else that suggested itself, we attacked the problem of distilling petroleum in considerable quantities (8,000 to 12,000 gallons) under pressure of about five atmospheres. The first still we built was of a welded design and was planned to handle 100 gallons of the high-boiling fractions. Obviously, the raw material first to be tried consisted of the so-called "fuel oil," or reduced crude, meaning the residue of crude oil after the more valuable products had been removed. We soon found that we could not work profitably with this product; when distilled with or without pressure it produced quantities of coke that deposited on the bottom of the still and caused a red hot bottom that would not stand any rise in pressure.

The next proposition comprised the use of high-boiling distillates from the crude, viz., oils boiling from 225° C. upwards. By using these oils as raw materials we secured our first encouraging results. We distilled these distillates at a pressure of about five atmospheres and were thereby able to hold down the temperature to a moderate figure, the cracking being done in the so-called "liquid phase." By doing the work in this way we found to our intense gratification that the low-boiling fractions produced belonged mostly to the aliphatic or paraffin series, which were easily deodorized and finished into products suitable for sale. Further, the field of salable liquid was good, and the production of fixed gasses and coke was small.

Construction of Equipment

Experimentally, therefore, our work was successful. But the big problem remained to be solved. Could we build large equipment that would, in a practical way, secure the desired results and at the same time be durable and reasonably free from the fire hazard that always attend operations in an oil refinery? Some of our practical men said we could, but more of them said we could not. In this case, however, the majority was overruled, and we immediately prepared plans and specifications for a still 8 feet in diameter and 20 feet long, built of ½-inch mild steel plate, which would charge 6,000 gallons of raw material. It had a safety factor of 5, the working pressure to be 100 pounds, and the bursting pressure 500 pounds.

The still was built and charged with many misgivings on the part of the doubters, but with boldness and confidence exhibited by the rest of us. So soon as we had the still hot and pressure began to develop, we encountered our first difficulty. The still was built in a workmanlike manner and would have made a good steam boiler, but we found rivets and seams leaked badly under oil pressure where they would not under steam pressure. It was difficult to induce boiler-makers to calk these leaks while the still was hot and under pressure, but we found men bold enough to do it, and the first run was sufficiently encouraging to induce us to proceed further. But the leaks persisted until Nature came to our aid and the minute portions of oil in the leaks gradually carbonized and they closed without our aid.

The experiments with the large still proved our results with the small one, viz., the yield of suitable gasoline fractions was good; the loss was trifling; the cost was reasonable, and the fire hazard under close caution and supervision was not excessive. Further, we were astonished to find that the residue remaining in the still contained substantial qualities of asphaltine actually created (from a distillate containing none of it) by distillation under pressure.

We learned early in the work that operating at moderate pressure required a substantial dephlegmating system that would return to the still fractions boiling too high for our purpose, and allow the others to pass on.

A suitable safety valve that would operate properly with oil vapors at high temperatures had to be devised. After making a number of runs with our 8 x 20 still, and in view of the fact that the demand for gasoline was increasing at a rapid rate, we asked for an appropriation of one million dollars to build sixty pressure stills 8 feet in diameter and 30 feet long, each charging 8,000 gallons of raw material. It required considerable argument to convince some of our directors that such a revolutionary proceeding would possibly be successful, but finally they consented to it, and the work started.

It would require much more time than I have at my disposal this evening to give a full account of the minor difficulties that arose. We had solved the big points, but there were many smaller ones. For successful results we must operate with the oil at temperatures from 370° to 400° C. in the still. At 450° C., steel begins to lose its tensile strength and its capacity to withstand pressure. It is clear, therefore, that with this narrow margin great caution must be exercised to prevent overheating. The human element enters here, as it does in every feature of pressure-still operation, but we operated over eight years with hundreds of these stills in daily use, and manufactured millions of barrels of gasoline by this method before we had a fatal accident.

Commercial Application of the Process

From the humble beginning of the 100-gallon still in our experimental laboratory, the Standard Oil Co. of Indiana has in operation today over 800 pressure stills having a gross charging capacity of 8,000,000 gallons, and licensees under our patents are operating as many more, giving a daily production of 2,000,000 gallons of gasoline out of about 12,500,000 gallons total daily output in the United States and Canada.

This amount of gasoline makes possible the use of 2,000,000 motor vehicles more than could be otherwise have been supplied from a given consumption of crude petroleum, and as a corollary of that proposition and assuming 20 per cent. of gasoline as a normal average yield from crude oil, the pressure-still process is conserving for future consumption an amount of crude oil nearly equal to 100,000,000 barrels per year.

Gasoline Consumption

The consumption of gasoline by internal combustion engines during the past decade has increased at a terrific rate. In 1910 the United States consumed approximately 700,000,000 gallons. While for 1920 the Bureau of Mines statistics show a total gasoline production of 4,600,000,000 gallons, of which 850,000,000 were made from natural gas, something over 3,000,000,000 gallons made by straight crude oil distillation, and 750,000,000 gallons made by the cracking process. Further, statistics show that while the increase of crude oil production during the past decade has been 142 per cent, the increase in gasoline production has been over 700 per cent., and although some of the gasoline has been exported, the larger portion has been consumed by the ever-increasing number of automotive vehicles in this country.

The increase in production of crude oil has not been commensurate with the increased demand for its products, and the pressure-still process filled at least part of the gap. Naturally, one is inclined to speculate on what the future will be regarding an adequate supply of these important commodities. One suggestion would be that some of the largest amounts of oil now being used for fuel and gas-making purposes be replaced with coal, and substantial portions of the oil used for making gasoline; the coal consumption, in turn, to be replaced in part by the further development of hydro-electric power.

The American people are notoriously wasteful in the use of natural resources with which they are so richly endowed. It is hoped the work outlined above will be considered a slight contribution toward the curtailment of such waste.

It would be obviously unfair and unjust to close this paper without duly acknowledging the work done by my associates in successfully establishing the pressure-still process. Our patent attorneys, represented by Russell Wiles, contributed many useful and practical suggestions, and if it had not been for the invaluable assistance of Dr. R. E. Humphreys, F. M. Clark and T. S. Cooke, and many others connected with the Standard Oil Co. of Indiana, satisfactory results never would have been secured.

Utilization of Waste Slate as a Filler

By Oliver Bowles

Mineral Technologist, U. S. Bureau of Mines.

SUPPLEMENTING results obtained regarding the adaptability of pulverized waste slate as a filler in road asphalt mixtures, the Bureau of Mines has undertaken the problem of discovering new and enlarged outlets for this waste material produced in high percentage at slate quarries.

Many products such as paper, rubber, road asphalt, floor coverings, paints, etc., require as one of their important constituents a considerable percentage of finely pulverized inert mineral matter to give "body," to obtain the desired consistency, or to supply the necessary wearing or other qualities demanded. Such materials are known as "fillers." The possibility that slate flour might be used as a filler with advantage in several products other than road asphalt led the bureau to undertake further investigation.

Extension of Uses is Based on Price Advantage

It has been found that in some products slate may be substituted for materials now in use without any marked effect on the quality of the products. A wider use of slate in such products could result only from a definite price advantage as compared with other fillers. While it is probable that waste slate may be placed on the market at prices which will encourage its wider use, it is evident that a waste slate utilization industry can never attain sufficient magnitude to definitely assist the slate producers unless it is demonstrated that some definite advantage in quality may be gained when slate is substituted for fillers now in use. The main purpose kept in view throughout the inquiry has been, therefore, to find advantageous uses for waste slate in order that both producer and consumer may be benefited.

Mechanical Rubber Goods

Tests of the suitability of pulverized slate for mechanical rubber goods manufacture were made under actual working conditions by the co-operation of various rubber companies which were provided with samples of such fineness that 80 per cent. would pass through a 200-mesh sieve.

Of 18 reports 7 were unfavorable and 11 were favorable. Those reporting unfavorably claimed that the resulting rubber was inferior in tensile strength, stretch, and wearing quality. One manufacturer claimed that slate flour made the product dry and hard with a tendency to crack. Several reports were received to the effect that the slate submitted was insufficiently ground, and that finer grained filler would give better results. Only one manufacturer expressed a preference for coarse-grained filler.

Eleven manufacturers found that slate flour was a satisfactory filler for such products as disks, sheet packings, molded shoe heels and soles, hard rubber battery jars, carriage tires, garden hose, clutch facings and similar products. Slate flour was used successfully as a substitute for whiting, clay, ground barytes and aluminum flake.

A manufacturer of rubber footware found that products in which slate was used compared favorably with those made from regular compounds in tensile strength, elongation, and accelerated or natural aging, but repeated stretching caused the rubber to break more readily than when regular compounds were employed. The chemist in charge of the tests concluded that this latter quality was due to the coarseness of the slate filler, and suggested that finer grinding would overcome the difficulty.

The chemist in charge of a compounding test in which were used 40 per cent. respectively of whiting, china clay and slate flour, reported that "slate flour shows up very well; if the price is low enough it can be used advantageously." The differences of opinion of those co-operating in the tests arises largely from insufficient grinding of the sample submitted.

The weight of evidence points to the probability that finely pulverized slate is a satisfactory filler for mechanical rubber goods. It is important to note that it could be placed on the market at a price considerably lower than that of ordinary fillers now in use.

A few manufacturers who made tests of slate flour as a filler in rubber such as is used in automobile tires report unanimously that slate flour is not as satisfactory as fillers now in use. It is felt, however, that the evidence is not to be regarded as conclusive until extremely fine grained material has been tested.

Linoleum, Oil Cloth and Window Shades

Oilcloth, linoleum, other floor coverings and window shades all contain a varying percentage of mineral fillers. In oilcloth the content of filler varies from 40-70 per cent., depending on the grade. In linoleum it constitutes about 20 per cent. of the total mass, with a large proportion in the backing. English and domestic china clays are used in white oilcloth and white window shades, while colored fillers may be used in other products. Red slate flour and pulverized red shale are used as a backing in red linoleum, and as a constituent of felt-base floor covering.

The ordinary mineral fillers used are clay, whiting, barytes, asbestine (a form of talc), ochre, limestone and slate flour. Products having colors other than white require as fillers any low-priced inert mineral product in pulverized form, 95 per cent. to 100 per cent. of which should pass a 100-mesh screen. At the present time a considerable tonnage of red slate flour and pulverized red shale are used in the linoleum and other floor covering industries, but little slate flour of any other color has yet been employed.

One company found that slate flour was too gritty to be used successfully. No information has been obtained as to the fineness of the material tested, and it may be that fine grinding would overcome the gritty property. A manufacturer of shade cloth found that a sample of slate flour submitted by the Bureau of Mines was satisfactory as a filler. Its use would depend largely on the price as compared with that of pulverized limestone.

Another manufacturer of shade cloth found that slate flour was satisfactory, except that difficulty was encountered in mixing it with water as it had a tendency to "ball up." Experiments are now being conducted with the view to overcoming this difficulty by mixing with all or by grinding in oil and water. Tests made on samples of oilcloth by one manufacturer indicate that slate satisfactorily replaces the china clay ordinarily used as a filler, but the same difficulty was experienced in mixing with water as noted in the preceding paragraph.

The great advantage in price of slate flour over china clay should encourage further experimentation directed toward overcoming the difficulties encountered in mixing the filler. It seems probable, therefore, that oilcloth, floor covering and window shade materials, with the exception of those that are white in color, may be manufactured successfully using slate flour as a filler. Slate flour compares favorably in price with the cheaper grades of filler such as ground barytes, off-color talc, impure clay and pulverized limestone or marble. When substituted for china clay the advantage in price is much greater. It is evident, therefore, that a considerable saving could be effected by substituting slate flour for fillers now in use in these products.

Plastic Roofing and Flooring

About 75 per cent. of the volume of certain types of plastic flooring is made up of pulverized slate. The insoluble character of slate renders it of especial value for acid-proof plastic flooring and lining for acid tanks.

Roofing mastic is commonly made from a mixture of coal tar and slate flour. It is used to form the bed on which roofing tiles are placed, and to fill the joints between them. It is used in the same way with rectangles of slate on flat slate roofs. Both pulverized limestone and slate are used as fillers, and the choice of material depends chiefly on the price. Fillers used by some companies may be manufactured at low cost, as extreme fineness of grain is not required, material which averages 75 per cent. through 100-mesh or even coarser being employed. Other manufacturers require material of such fineness that 75 to 85 per cent. will pass a 200-mesh screen. The cost of manufacture will of course depend largely on the fineness desired.

Slate flour as a filler in plastic products has passed the experimental stage, for it proves to be well adapted for such purposes and is now used in large quantities. One company now employes about 50 carloads of slate a year in the manufacture of plastic products. An extension of its use depends almost entirely on the ability of grinding companies to place it on the market at prices that will compete with those asked for pulverized limestone and other low price fillers.

Summary

All of the information available indicates that waste slate may be used to advantage as a filler in mechanical rubber goods and in some classes of oilcloths, floor coverings and window shades. Apparently it is not adapted for use in rubbers of a grade used in automobile tires. For plasstic roofing and flooring products containing coal tar it has long been in use and constitutes a very satisfactory filler. Several hundred carloads per year of waste slate are probably used for this purpose at the present time.

For some products, particularly for rubber, a much finer grained slate flour than any now on the market is demanded. One of the most promising ways in which manufacturers of pulverized slate can promote a wider use of slate flour is by producing a uniform reliable product at least 95 per cent. of which will pass a 300-mesh screen, and by introducing such a product among manufacturers of mechanical rubber goods, linoleum, oilcloth, phonograph records and other products requiring extremely fine-grained filler.

Rubber Service Laboratories, Inc., Akron, Ohio, has acquired a site at Nitro, W. Va., and will erect a plant for the manufacture of rubber chemicals and [illegible]

Scientific Training and Salaries in the Bureau of Standards

One of the greatest services which the Bureau of Standards performs for the industries is the training of men for scientific and technical research work, says Dr. S. W. Stratton, director of the Bureau, in his report of its work for the last fiscal year, just issued. Many young men receive what is, in some respects, better than a postgraduate course by working in some of the minor scientific positions at the Bureau during the years immediately following the completion of their college course. These men then go into the industries with a better conception of the problems of research work.

In this connection it should be mentioned that while the entrance salaries in these lower-grade positions are perhaps sufficient those paid the more experienced members of the scientific staff are wholly inadequate. This has resulted in the present difficulty of retaining the most valuable men in the government service. It is assumed that as soon as possible this unsatisfactory condition will be remedied and the salaries of these experts placed more on a plane with the compensation for similar work in industrial and even educational institutions. Unless steps are taken to meet this situation it will be impossible to maintain the Bureau's staff on the high plane of efficiency which it has always occupied.

Dr. Stratton emphasizes the great disparity between the salaries paid scientific and technical experts in the government service and men engaged in similar work for industrial concerns and educational institutions. This is a real menace to the research work of the government, which in time will be felt by every industry and individual throughout the country.

While, as stated above, the Bureau can offer a reasonably good entrance salary to young men just out of college, it can not compete on anything like equal terms with outside organizaitons when the more responsible positions are considered. The men in these positions are among the most valuable in the governor's employ, and many have voluntarily remained in the service from a sense of patriotic duty and at large financial sacrifices. On the hand, a large number have been forced to accept positions with private corporations, schools, and colleges, although in doing so they realize that the opportunities for research will be far less than in a National institution.

There should be no need for such sacrifices as those just mentioned. The government can afford to pay and should pay its experts a salary on a plane with that which they can earn in private employment. This matter is particularly serious in the case of the Bureau of Standards, as its sole product is scientific information, which is dependent entirely upon scientific research of the highest grade. Many of the investigations necessarily cover long periods, and the loss of the expert in charge may be equivalent to setting back the whole investigaiton for a year. Dr. Stratton earnestly recommends in his report that steps be taken immediately to remedy this situation, the seriousness of which is becoming greater each year.

Contemporaneously with the distribution of the 1922 spring season Shade Card by the Textile Color Card Association of the U. S., Inc., the National Aniline & Chemical Co., 21 Burling Slip, New York, has issued its "Dyer's formulas" for use in matching the colors shown on the Shade Card. It contains recipes for duplicating the popular shades on silk, cotton and wool and is indispensable to dyers.

Sulfuric Acid Manufacture Without Chambers and Towers

THE production of sulfuric acid from gases containing sulfurous acid, as roasting-furnace gases and the like has, apart from the so-called contact process, never been carried out on a large scale without using lead chambers or towers. Although a number of proposals have already been made for the production of sulfuric acid without chambers and towers, these proposals have not led to any practical result, principally because with the proposed means no really intensive gas liquid reaction could be obtained, since for this purpose the gas containing sulfurous acid must be brought into intimate contact as quickly as possible with a constantly renewable, exceedingly large quantity of finely divided nitrosyl acid.

By an extremely large amount of nitrous acid is to be understood an amount so large that in contact with any SO_2-content occurring in the plant the power of the nitrosyl acid to oxidize SO_2 is maintained unconditionally; therefore, there is no nitrosyl acid in the plant which is so weak as to be inactive. Furthermore it is necessary to keep the strength of the nitrosyl acid within certain limits, in order that on the one hand sufficient water for quick reaction may be present in the acid and on the other hand the capacity of the acid to contain nitrous gases and to take up nitrous gases that have been liberated may nevertheless be preserved.

According to the present invention,* the problem of producing sulfuric acid without lead chambers and towers in an economical manner with proved success on a practical scale is solved by bringing into contact with the gases containing sulfurous acid, the largest possible amount of nitrosyl acid of between 54 and 58° Bé. strength, and in an extremely fine state of subdivision, in a mixing chamber, preferably by means of mechanical devices of suitable construction.

The gases after having traversed the mixing device may be conducted advantageously through a chamber of moderate dimensions irrigated with nitrosyl acid of the same composition as that in the mixing chamber. By this means, the nitrous gases set free during the reaction in the mixing chamber have an opportunity of again exerting an oxidizing action on sulfurous acid, and are absorbed in the irrigating chambers to be returned in a dissolved condition to the mixing chamber, so that the proportion of nitrous contents in the acid there remains practically unaltered.

One mixing chamber and one irrigation chamber alone or one mixing chamber form in themselves a working unit to which further units of the same kind may be attached as required. The mixing and irrigation chambers may be arranged in any way, provided the mixing chambers in particular are adapted to enable the most intimate possible contact of large amounts of acid with the gases in a short time.

There already have been disclosed processes for manufacturing sulfuric acid with the use of the customary lead chambers or reaction towers in which the SO_2-containing gases are brought into contact and into reaction with nitrosyl sulfuric acid by the help of mechanical mixing devices. In all these processes, however, the SO_2-containing gases are brought together with the nitrosyl acid in counter-current. These gases completely de-nitrate the nitrosyl acid, whereby nitrogen oxide gases enter into the gas mixture, while sulfuric acid free from nitrogen oxide remains behind or runs away. The nitrogen oxide gases originating in the gas, however, are absorbed, after the SO_2-content of the gas mixture has practically completely disappeared, by pure sulfuric acid.

Thus in all these known processes in the initial part of the plant where the fresh SO_2-containing gases enter it, there is found de-nitrated sulfuric acid. Furthermore the nitrogen oxide content of the acid increases until at the point where the SO_2-content of the gases is approximately zero, it reaches its highest value. Thereafter the nitrogen oxide content of the acid decreases again until the end of the plant, because there sulfuric acid free from nitrogen oxide is yielded.

In contrast to this, in the present process the plant at the beginning, in the middle, and at the end, that is, in all stages of the process, is provided with nitrosyl sulfuric acid of the same nitrogen oxide content and in such amounts that everywhere in the plant nitrosyl acid capable of reacting is present and runs away. The nitrosyl acid running away from the individual devices differs somewhat in its nitrogen oxide content; it is collected and mixed and immediately returned to the circuit.

Only so much nitrosyl acid as about corresponds to the daily production of sulfuric acid is drawn off and denitrated to form commercial acid. This denitration, however, does not belong to the carrying out of the reaction in the present process, but can take place separately, for example, in the Glover tower of a chamber system. Because in the present process in all parts of the plant where sulfuric acid formation takes place, especially, however, in the first part where large amounts of SO_2 are still present, the nitrosyl acid is never denitrated to inactivity, there is obtained in combination with the fine subdivision of the nitrosyl acid a hastening of the oxidation of the SO_2-content of the gas hitherto never reached, and with it the practical possibility of producing sulfuric acid in relatively small mechanical mixing devices on a large factory scale.

Description of Equipment

In order clearly to understand the invention, reference is made to the accompanying diagrams which show in elevation and plan a plant consisting of several mixing and irrigation devices. *a* is the inlet pipe for the gases containing sulfurous acid, for instance, ordinary roasting-furnace gases from pyritic zinc blend and the like, or also pure or waste gases from metallurgical or chemical processes. *b* is a proposed denitrating chamber which, however, does not necessarily have to be connected to the plant according to this invention; it is only preferable to insert it at this place. *d* is a connecting pipe leading from the denitrating chamber to the first mixing chamber *e'*.

The mixing chamber may be arranged in a variety of ways, all that is necessary being that the [illegible] shall effect the most intimate possible contact between the nitrosyl and gases. The mixing chamber according to the diagram consists of a box-like acid-proof and gas-tight receptable which is filled about one-half with a solution of nitrosyl acid in sulfuric acid. Each mixing chamber is provided with a roller p^2, p^a, etc., of acid-proof material, rotatably mounted and just touching the acid with its periphery or dipping slightly therein.

---

* U. S. Letters Patent No. 1,399,526, issued December 6, [illegible] Theodor Schmiedel and Hans Klencke and by them [illegible] Greutert & Cie., Basel, Switzerland.

A driving pulley t to t^n, is mounted on the elongated spindle s to n of the roller. The nitrosyl acid is centrifuged in the form of a fine spray into the gas chamber over the roller by the rapid revolution so that the gases passing therethrough come into intimate contact with the spray. Part of the gases are drawn into the nitrosyl by means of the roller and issue behind the roller, to reunite with the gases passing over the roller.

Above the mixing chamber e' is a container f' charged with filling material which is irrigated with acid through the inlet pipe n' to n^6, which acid runs into the mixing chamber e'. The gases leaving the mixing chamber are thus forced to pass through the irrigating chamber f' and thence through the communication pipes d' into the next mixing chamber c^2, with adjoining irrigation chamber f^2 and so on as required. The mixing chambers and accessories are arranged in cascade form in such way that the acid flows by itself from the uppermost mixing chamber down the lowest, by way of the overflow pipes g^n, g^2, g', etc., and the inlet funnels h^n, h^2, h', etc., provision being made for keeping the acid at uniform level by suitably adjusting the overflows.

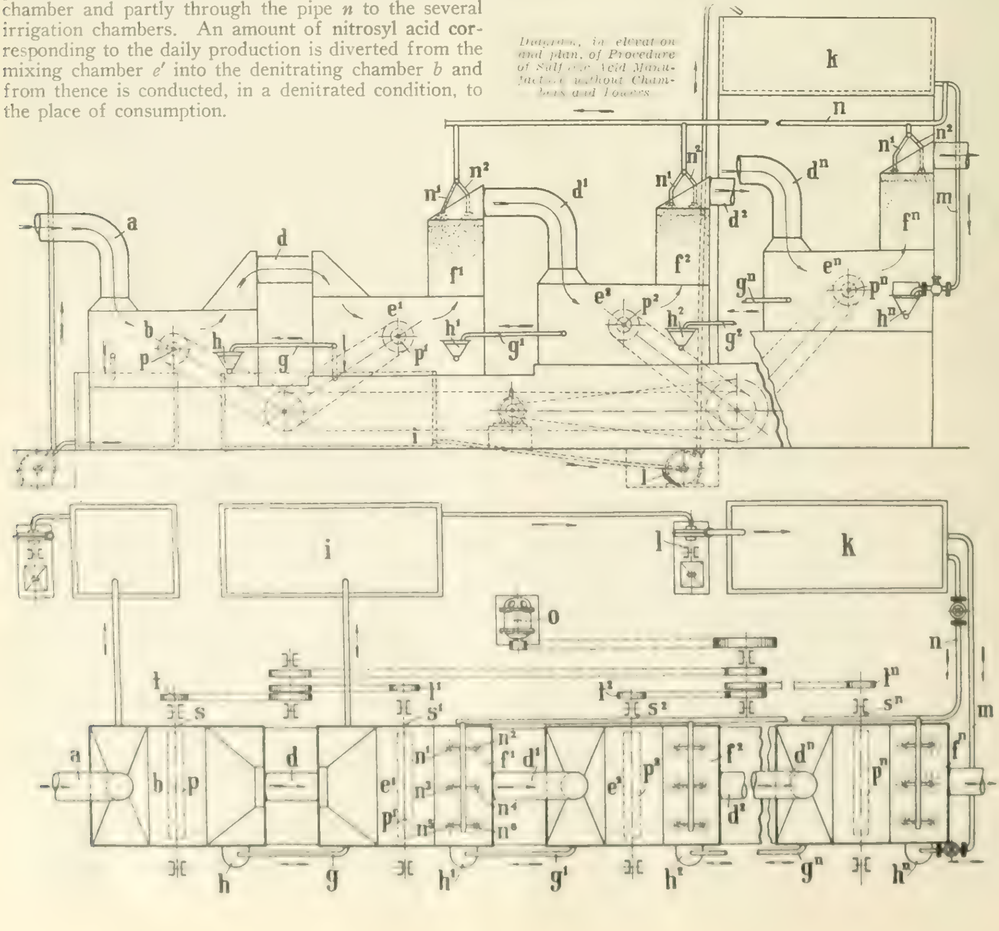
The acid comes from the mixing chamber e' into the acid circulation tank i from which it is raised by the pump l into a high level tank k. From this it flows partly through the pipe m into the uppermost mixing chamber and partly through the pipe n to the several irrigation chambers. An amount of nitrosyl acid corresponding to the daily production is diverted from the mixing chamber e' into the denitrating chamber b and from thence is conducted, in a denitrated condition, to the place of consumption.

The individual rollers in the mixing chambers are driven by the motor o by means of belting. Instead of arranging the several chambers and tanks in cascade form, they also may be arranged on the same level. In this case the supply of acid to the irrigation chambers and its removal from the mixing chambers are effected in parallel.

Procedure of Operation

Nitrosyl acid of uniform composition is passed continuously through the mixing and irrigation chambers, water or nitric acid in desired amounts being added in order to maintain the nitrosyl acid constantly at the required strength of 56° Bé. and at a suitable concentration in nitrosyl, the composition being always in a state of change through the absorption of the generated sulfuric acid and through the normal loss of oxides of nitrogen. The drive of the rollers of the mixing chambers is started so that the gas space above the rollers is filled with a fine nitrosyl spray.

As soon as gases containing sulfurous acid of any strength whatsoever, hot or cold, encounter the very fine spray of nitrosyl acid (of about 56° Bé. strength) in the first mixing chamber a very brisk reaction is set up at once between the two in consequence of the exceedingly great opportunity afforded for contact. That part of the gases which is forced in an extremely fine


Diagram, in elevation and plan, of Procedure of Sulfuric Acid Manufacture without Chambers and Towers

state of division into the nitrosyl by the roller is entirely oxidized therein.

The result of this action is that a considerable part, up to 50% of the sulfurous acid, is oxidized in the first mixing chamber and that a corresponding amount of nitrosyl gases enter the gas mixture. Inasmuch as the gas mixture was in contact with comparatively strong sulfuric acid its percentage of water has become too small for further oxidation to take place in the form of a normal gas reaction, and a tendency is set up for the formation of nitrosyl-sulfuric acid or the deposition of chamber crystals. This is prevented by the gas mixture being now wetted in the intermediate chamber connected to the mixing chamber, with nitrosyl of the same concentration as that of the mixing chamber whereby nitrosyl-sulfuric acid is dissolved and the reaction between gas and liquid is again rendered possible. At the same time the irrigating acid redissolves the nitrous gases liberated in the mixing chamber and returns them into the mixing chamber so that its stock of nitrosyl is essentially maintained.

One mixing chamber and one irrigating chamber thus form a complete aggregation which, given a slow flow of gas, is adapted to carry out the acid-forming process by working up the SO_2 gases and recovering the nitrogen-oxygen compounds. Consequently it is not always necessary to pass the acid in a single current against the gases but the mixing and irrigation chambers may be supplied in parallel with acid of uniform composition. Therefore, if desired, the repeated circulation of acid, hitherto essential in chamber and tower systems, may be dispensed with.

The practical advantage of this circumstance is that the quantity of acid and therefore of nitrosyl supplied to the individual mixing chambers connected in parallel to the acid supply can, if desired, be varied at any time and independently for each. The gas mixture leaving the irrigation chamber is passed, if necessary, through further mixing chambers alternating with irrigation chambers until the content in sulfurous acid is almost completely exhausted. Since, in this method of working, the content of nitrous gases in the gas mixture at any time corresponds only to the amount of sulfurous acid coming into action at a given point, both the sulfurous acid and the gaseous nitrosyl have disappeared from the final gases, at the end of the system. These gases therefore, immediately can be discharged into the open air.

For the production of commercial acid, an amount of nitrosyl acid which corresponds to the daily production must be denitrated. This is effected by setting up in front of the first mixing chamber a similarly constructed denitrating chamber into which part of the nitrosyl acid is admitted and from which the gas mixture is passed into the first mixing chamber proper, without passing through an irrigation chamber. The denitrated acid is drawn off separately and stored.

In this way a large quantity of sulfuric acid can be produced in a small space and with a comparatively small consumption of nitric acid and power. Since the prime cost of the plant is small, extensive buildings such as chambers and towers being dispensed with, a highly important improvement on this account as well is introduced by the new process.

Margarin and Vitamines

THE manufacture of margarin is a creation of applied chemistry that represents today an investment of forty million dollars. It is an example of conservation in its most utilitarian aspect, for on one hand it has dignified the use of a great raw material and on the other utilized a product of agriculture to make a food fat within the means of millions to whom butter is a luxury.

Margarin (artificial butter) has come to mean a compound of refined cocoanut oil and of whole milk or of milk from which butter fat has been removed, i. e., skimmed milk. The dairy interests look with aversion upon a product which is a sanitary, healthful substitute for the superior grades of dairy butter and, regardless of the interests of the consumer, resort to misrepresentation as to the presence in the artificial product of the vitamines which scientific research has disclosed are not only essential to physical growth in the young but to the absence of disease arising from the lack of vegetable food.

Of these growth-promoting substances, at present three are distinguished, designated for want of more detailed knowledge concerning them as fat-soluble A, water-soluble B and anti-scorbutic C. The first two are generally distributed in vegetables, cereals, meat, milk and eggs and are not injured by cooking unless it is unusually prolonged. On the other hand vitamine C is found chiefly in fruits and is early destroyed by heat. Green vegetables, sprouting seeds and milk also supply this constituent. Vitamines A and B are not so likely to be absent from the average diet as C.

If the diet of an animal is lacking in any one of these three vitamines, no discomfort may be noted for some period of time, but later, symptoms will develop characteristic of the lack of each. Those who have a large choice and use a variety of foods need not fear those diseases which are caused by the lack of vitamines.

These facts are well-known to food chemists, dietitians and researchers in physiological chemistry, who also appreciate not only the great variations in the occurrence of vitamines in their natural sources but the conflict of opinion concerning changes they undergo in the various treatments and transformations of the materials containing them. Consideration is given the subject because of the frequent misleading contributions in the press which have the effect of condemning unjustly a worthy product.

These articles seek to give the impression that milk and butter fat are always rich in fat-soluble vitmines and that margarin is always poor in them. The facts are that there are large quantities of milk and butter that are quite deficient in these vitamines, and large quantities of margarin that are sufficiently rich in them to satisfy all physiological requirements with respect to vitamine content.

Steenbock* says that the vitamine content of butter varies with the breed and feed of the cow. He reported one experiment in which the butter fat of a cow fed exclusively on alfalfa hay did not contain any fat-soluble vitamines.

Dutcher† recently said: "[illegible] variations in the vitamine content of milk we have observed marked effects of climatic conditions. Periods of drouth, followed by browning of the pastures and drying of the grass, are reflected in the growth curves of the experimental animals. These results are in agreement with those which were obtained in a similar study on the antiscorbutic vitamine. Other investigators have reported similar observations. It is quite evident that the water-soluble vitamine does not fluctuate to any considerable extent, on account of the fact that most dairy animals receive some grain.

---

*Journal of B[illegible] 1918

†Journal of [illegible]

"This is not true for all dairy stock, however, for the writer has seen cattle go through the winter on some western farms on a diet composed very largely of straw. There is little wonder in such cases that the animals have a rough, unthrifty appearance by the time the spring months arrive. Certainly the milk and butter from such animals must be almost devoid of vitamines. It may be said, for the benefit of Dr. Steenbock, that our vitamine-poor butter was practically colorless."

It is also well known that butter fat gradually loses its vitamine potency during storage. It is not known just what effect the modern method of butter making has on the vitamines in milk, viz., the practices of "neutralizing," "deodorizing," and "pasteurizing" of high acid cream or "stale" cream.

From the foregoing facts, it is certain that there are millions of pounds of butter on the market that are quite deficient in vitamines. But even in the face of this fact, there are numerous articles appearing in farm and dairy journals to the effect that milk fat or butter fat is always teeming with these necessary vitamines and that dairy products are therefore indispensable sources of them.

Nor is this the only way the public is deceived with respect to butter. The "colorless" butter, referred to by Dutcher as deficient in vitamines, is artificially colored to look like yellow "June" butter which is known to be rich in them. This is a violation of all State and Federal food laws. A food product "shall be deemed to be adulterated if it be colored, powdered, coated or stained in a manner whereby damage or inferiority is concealed," according to the Federal food and drugs act of June 30, 1906. Every State in the Union has the same provision of law. These laws are not only not enforced with respect to butter, but there is no administrative requirement that such butter must be labeled to show that it has been artifically colored. Such immunity is not enjoyed by any other article of food.

Now what are the facts about margarin?

Halliburton and Drummond** found by experiment that one type of margarin "is nutritively the equivalent of butter" in every respect. The other type of margarin does not contain less fat soluble vitamines than the "June" butter, but it would appear to be just as efficient as the butter produced from the milk of cows on a vitamine-deficient feed during the long periods of the year when there is no green feed, or the butter that has been in storage several months. Later experiments, too, have shown that some of the fats and oils used in the manufacture of margarin hitherto thought to be deficient in vitamines have been found to be fairly efficient in this respect. Daniels and Loughlin*** found that rats fed on a ration from which all fat-soluble vitamines had been removed except what was in the lard of the ration "grew normally, reproduced, and reared their young." They got the same results with cottonseed oil.

There has been so much false advertising and propaganda indulged in by so many agencies in connection with this subject that the nutrition experts of the country have themselves taken notice of it and have sounded notes or warning against it.

Even if cocoanut oil were found to be entirely free of fat soluble vitamines, which fact has never been established, it is never eaten as cocoanut oil in this country. It is always mixed with milk in the form of margarin or other milk compounds. Whenever milk has vitamines in it, these milk compounds likewise have vitamines in them. Not only have no definite quantitative experiments on the vitamine content of different kinds of foodstuffs never been made, but the vitamine content of butter fat varies all the way from none to a sufficient quantity to satisfy the nutritive requirements from that standpoint.

When we consider that there are about 25 common articles of food containing vitamines, the ulterior motive involved in the persistent misrepresentation as to their presence or absence in a particular one of these is obvious to all.

Synthetic Gold

To allay the fear of the destruction of the utility of gold as a measure of value and a basis of currency, induced by the press reports that synthetic gold soon may be commercially possible, the U. S. Geological Survey finds it necessary to say:

"While modern chemistry has shown that some of the supposed elements are really compounds that might be divided into simpler substances by special chemical processes, thus making it unsafe to state positively that manufacture of artificial gold is impossible, yet if any process can be found it will probably be so expensive and difficult to operate that the product will be more expensive than the natural metal."

Gas Warfare Condemned

A resolution, drawn up by Elihu Root, barring the use of poisonous gas in warfare was unanimously approved by the advisory committee of the American delegation and was unanimously adopted at Washington on January 8 by the Committee on Limitation of Armament. The five powers, through their representatives at the Conference, endorsed the declaration against gas warfare. The report of the committee on poison gases, Charles E. Hughes, Chairman, as presented at the meeting of the Committee on January 6, in its consideration of the subject presented the following declaration:

> "Whatever may be the arguments of technical experts, the committee feels that the American representatives would not be doing their duty in expressing the conscience of the American people were they to fail in insisting upon the total abolition of chemical warfare, whether in the army or the navy, whether against combatant or non-combatant. Should the United States assume this position, it would be no evidence of weakness but of magnanimity. Probably no nation is better equipped by reason of scientific knowledge among its technicians and by means of its material resources to use chemical warfare effectively."

* * *

The River Rouge coke oven plant of the Ford Motor Co., produced more than 5 million cubic feet of gas during 1921. About 45 per cent. of this gas was used in heating coke ovens, 10 per cent. for other purposes at the Rouge plant, over 20 per cent. were delivered to the Highland Park plant of the Ford Co., and 25 per cent to the Detroit City Gas Co. From 349,034 tons of high volatile coal and 161,363 tons of low volatile coal used during this period were produced, in addition to the gas, the following quantities of by-products: coke, 376,139 tons; tar, 4,321,608 gallons; motor benzol, 2,490,602 gallons; ammonium sulphate, 15,706,907 lbs

---

** [illegible] September 1921.

*** [illegible]

Treatment of Water for Steam Making

By Julian S. Simsohn

Consulting Chemical Engineer

THE subject of water has been generally regarded in the past as a problem for the chemist, so that the difficulties in its use for boiler purposes have hitherto been passed to him, and, based on his analyses and recommendations, chemicals are added in an effort to prevent scale and corrosion, with more or less success.

There were engineering features, however, that should have been considered—questions of boiler circulation, variations in operating conditions, temperatures and boiler pressure—and it was the realization that all these are necessary in the consideration of water for boilers that has placed the problem outside the realm of the chemical laboratory and over into the field of the chemical engineer.

Since the earliest history of boilers, scale formation has always been a source of difficulty and waste, but with low ratings the scale accumulation was quite limited, and that which did form was largely of a porous nature and quite easily removed. Its insulation value made its appearance felt on the coal pile, but the low cost of fuel up to comparatively recent years gave rise to the attitude that the scale situation was not of major importance in power-plant practice.

Modern operating conditions, however, have created new considerations, and high overrating of boilers and intense furnace temperatures, together with the high cost of fuel, have placed water among the important factors in the economical operation of the power plant.

Schuylkill River Water

As it falls from the clouds as rain water dissolves the atmospheric gases, oxygen and carbonic acid, and, gathering itself together in streams and rivers, it makes manifest its great erosive powers and solvent qualities. It is this rain water with approximately 15 cc. of carbonic acid and 30 cc. of oxygen per gallon that is slowly dissolving away the bedrock of the Schuylkill River, and in such quantities that in the 150 million gallons of Schuylkill River water which Philadelphia uses daily there are more than 50 tons of this rock invisibly moving through the city mains, with a proportion for each boiler.

A typical analysis of filtered Schuylkill River water is as follows:

	Parts per Million
Magnesium carbonate	23.0
Calcium carbonate	1.0
Calcium sulphate	66.5
Silica	6.4
Iron oxide and alumina	2.0
Incrusting Solids	98.9
Sodium sulphate	9.8
Sodium chloride	8.2
Organic and volatile matter	5.1
Non-incrusting Solids	23.1
Total Solids	122.0

The mud in the raw river water has been removed by filtration so that suspended solids are not shown in this analysis. The temporary hardness, i. e., the carbonates of magnesium and calcium, is represented by only 24 parts per million, while the permanent hardness, i. e., the calcium sulphate, is present in much larger quantities.

Effect of Alum Treatment

It is important to realize that in most filtration plants alum or aluminum sulphate is utilized in flocculating and coagulating the finely divided particles of mud. While this naturally improves the physical characteristics of the water and permits the tap supply to be clear and colorless, it nevertheless has a very marked effect on the water for boiler use.

Aluminum sulphate itself is a soluble salt and its efficacy as a coagulant depends upon its conversion to aluminum hydrate, the flocculent precipitate, in the following manner:

$$Al_2(SO_4)_3 + 3Ca(HCO_3)_2 = 2Al(OH)_3 + 3CaSO_4 + 6CO_2$$

Therefore, if an analysis of unfiltered river water be compared with an analysis of the same water after it has passed through an alum filter, it will be seen that, though the total hardness remains the same, the permanent hardness will be greater in the filtered water and the temporary hardness will be correspondingly reduced.

Temporary Hardness

Temporary hardness can be reduced largely by boiling the water for a few minutes, which will render it more or less opaque; on cooling, a white precipitate will be formed, consisting of a mixture of carbonates of magnesium and lime almost insoluble in hot water. Permanent hardness (sulphate of calcium), however, is unaffected by heat and forms a dense, hard scale difficult to remove.

Therefore, the larger the amounts of alum added at the filtration plant, the more complex becomes the feed-water problem. It is far preferable for plants operating on river fronts to filter their own supply than to introduce into their boilers water with high permanent hardness with its increased scale-forming qualities and correspondingly high cost of chemical treatment. Well waters are usually harder than river waters.

It is not always practical or feasible to depend upon a feed-water heater for the removal of temporary hardness, for the same effect can be obtained chemically by the addition of either caustic lime or soda, which absorb CO_2 as shown by the following formulas:

$$Ca(HCO_3)_2 + Ca(OH)_2 = 2CaCO_3 + 2H_2O$$
$$Ca(HCO_3)_2 + 2NaOH = CaCO_3 + Na_2CO_3 + 2H_2O$$

Neither heat nor caustic, however, has any effect on the sulphate or permanent hardness; the precipitant for the sulphates of lime and magnesia is soda ash, or sodium carbonate.

Clark Soda-Lime Process of Water Softening

The oldest form of water softening, i. e., the Clark soda-lime process, depends upon the removal of the temporary hardness by means of lime in accordance with the reactions already discussed and the removal of the sulphates in accordance with the following formula:

$$CaSO_4 + Na_2CO_3 = CaCO_3 + Na_2SO_4$$

The outgrowth of this principle is the modern chemical water softener, which is nothing other than an external settling tank with such mechanical improvements as to permit suitable means of mixing the chemicals and facilitating sedimentation.

In certain cases the discontinuous principle is used, in which the water is permitted to react with the chemicals by standing until the reaction is completed. The precipitated lime and magnesium are allowed to settle and the supernatant softened water drawn off. In other cases the continuous principle is used, where the water and chemical enter at one point and the precipitation takes place along the path of the water

---

[*] Presented at a meeting of the Philadelphia Section of The American Society of Mechanical Engineers

The completion of any chemical reaction depends upon two factors, viz., temperature and excess of the precipitating agent. In other words, 10 per cent excess soda ash will soften the water much more rapidly than a 5 per cent. excess. Further, with any definite amount of soda ash the reaction will be much more complete at 200° F. than at 60° in the same length of time. We may expect to find the use of heat, particularly when exhaust steam is available, of decided advantage in water softening.

If, therefore, at 200° F. satisfactory results can be produced with less excess of soda ash, the hot process is advantageous in not only cutting down cost of chemicals used, but also in preventing a more rapid excessive boiler concentration. In very hard waters with, say, 10 grains of lime per gallon and upward, an external treatment is always advisable, but there are many cases where chemicals could be introduced directly into the feed-water heater or the suction of the pump and produce very excellent results with practically no cost for installation. For example, the Delaware River water with about 3 or 4 grains of lime per gallon does not offer much field for the external water softener, which under the best circumstances could only remove about half of the hardness.

Zeolites

The so-called "exchange" principle of water softening is based upon a remarkable discovery by Dr. Rudolph Gans, who found that when hard waters are passed through zeolites they are changed in character and become softened. These zeolites are sodium-aluminum silicates and are found in nature as such and can be closely imitated by synthetic compounds. A number of these artificial substitutes are claimed to be superior to the natural zeolites, but this is still a matter of dispute.

All, however, operate on the same general principle, namely, the exchange of lime and magnesia salts for sodium. The magnesia and lime sulphates are converted by this method into sodium sulphate as in the Clark process, but the temporary hardness or bicarbonates of lime and magnesia become sodium bicarbonate. This conversion, while completely eliminating all hardness to the zero point, is of extreme importance in boiler operation, since a certain amount of the carbonic acid from sodium bicarbonate is eliminated by the heat of the boiler and the remaining sodium carbonate concentrates by evaporation.

In waters of high temporary hardness it is necessary to remove a considerable portion of this temporary hardness by preliminary treatment with lime, which makes the process then a combination of the Clark and zeolite processes.

Another absolute method for scale prevention depends upon the process of distillation. It is carried out in the multiple-effect evaporator, making use of the familiar principle of conserving the latent heat of steam and utilizing the steam from the first effect to boil the water in the second. This method has found considerable use in plants where the make-up water is very small and where the elements of expense need not be considered.

In all these cases, however, expense, either of installation or operation, must not be permitted to be the governing factor in the selection of suitable water-softening methods, and the fact that a zeolite softener might be satisfactory and advisable when operating on Delaware River water, is no indication that it should be used in the treatment of the boiler condition where Schuylkill water is the source of supply.

Boiler Compounds

The complications which arise in the solution of the water problem and the variations which occur in the operation of any plant make it evident how hopeless are boiler compounds in solving the difficulty. The patent-medicine principle is just as incorrect when applied to boiler feed-waters as it is in the healing of human ailments.

Many materials used in these boiler compounds are harmful and injurious to the metal and some often guaranteed innocently by their manufacturers to be without effect on boiler metal, do in certain plants where operating pressures are high, corrode the metal and produce serious after-effects.

Boiler Scale

Carbonate of lime when precipitated under atmospheric conditions by heat or by chemical precipitants is a white amorphous precipitate. On standing it becomes crystalline in form, much the same as the mineral calcite, and in the boiler it becomes denser and forms a sludge. Part of the precipitation, however, apparently comes down in the crystalline form of the mineral aragonite, in which form it is represented in a carbonate of lime boiler scale.

The sulphate of lime becomes a hard, solid, compact and non-porous scale and is usually mixed with variable proportions of the carbonate. Most magnesia salts are finally converted by boiler temperatures into the hydroxide, which then floats to the top together with the carbonate of lime and is carried up with the steam into the steam pipes, engines and turbines. The soluble magnesia content of water is particularly hard to remove since it reacts more slowly with the usual precipitants.

This partially explains why the *percentage* of magnesia in the treated water is a greater *percentage* of the total hardness than in the untreated.

It is useless to attempt to make any statement as to the insulating value of scale in terms of its thickness, and the percentages of fuel losses as indicated in most charts of this character are likely to be exaggerated. It can be stated, however, that hard sulphate scales offer considerably more resistance to heat transference than a carbonate formation. Since, however, the average run of scale represents a mixture of sulphates and carbonates in varying proportions, there can be no definite figure placed on its insulation value.

The soluble salts in the boilers are those which are not precipitated by boiling, and are represented by chlorides and nitrates of lime, together with the sulphates, chlorides and nitrates of magnesia and sodium. Many of these salts are far more soluble in cold water than in hot, and since they are not volatile and do not pass over with the steam, their concentration in the boilers is worthy of attention.

Excessive Concentration

It is an easy matter to figure from the analysis of the feed-water and the number of pounds of evaporation just what concentration is reached at the end of any particular time. It is impossible to fix any definite limits as to just where the danger point lies since there are so many factors to be considered, but the consensus of scientific opinion is to the effect that with a 200-lb. working pressure there is no danger of deposition of calcium sulphate if the concentration is kept below 1,000 grains per gallon.

The effective treatment for excessive concentration is blow-down or the emptying and refilling of boiler with fresh water. Under all circumstances, however, intelligent use of blow-downs can be made to mean much in the saving of hot water, since the heat units with the present price of coal are worthy of every effort of saving.

A fairly accurate idea of the concentration may be obtained if an analysis of the raw water is at hand by knowing the evaporation per hour in gallons, the contents of the boiler, and the number of steaming hours. The author has in many instances checked up the analysis of salts in boilers with the theoretically calculated amounts and found the former figures to differ but slightly from the theoretical.

Corrosion of Boilers and Economizers

While the actions thus far considered deal with the deposition of soluble and suspended solids in the boiler, there is another action which may proceed alone or simultaneously, viz., corrosion. As noted earlier in the paper, there is usually present in water either free or half-bound carbonic acid or both, as well as soluble salts, which under the influence of boiler temperatures decompose, producing acids. Such acids, of course, attack boiler metal and corrode it, sometimes uniformly and sometimes locally in the form of pitting.

All organic matter decomposes under boiler temperatures through a series of stages, from the complex molecules until it approaches the simplest, namely, carbonic acid. The speed with which this reaction takes place and the completeness of the conversion naturally depend upon the variables of temperature, rating, boiler circulation, and other salts that are present. This carbonic or weak-acid corrosion usually takes place in economizer tubes, feed lines and economizer drums.

The condensate of exhaust steam is always slightly acid on account of the free carbonic acid which is passed over from the boilers together with the oxygen and sometimes other volatile acids. Economizers and the slower-circulating elements of boilers soon become coated with a red deposit or show signs of the formation of rust cones and pitted metal. These cones consist of a black iron oxide center surrounded by a yellow hydrate in a higher state of oxidation. The red deposit is almost entirely hydrated ferric oxide. This type of pitting is very easy to recognize by its barnacle-like formation.

Corrosion once started is difficult to arrest, as the action apparently continues for a long time after the carbonic acid has been removed, and it takes considerable alkali to prevent the extension of corrosion when once it has started. The simplest form of relief is the addition of caustic soda to a point where all the free carbonic acid has been neutralized, and the excessive amounts of soda can be regulated by blow-downs.

Another form of corrosion which affects directly the tubes and drums of the boilers is caused by the accumulation of certain salts, more particularly calcium nitrate, calcium chloride, magnesium chloride and magnesium nitrate:

$$\begin{aligned}
Ca(NO_3)_2 + H_2O &= CaO + 2HNO_3 \\
MgCl_2 + H_2O &= MgO + 2HCl \\
Fe + 2HCl &= FeCl_2 + H_2 \\
FeCl_2 + MgO &= MgCl_2 + FeO
\end{aligned}$$

Such waters in boilers become slightly alkaline on concentration and react pink to phenolphthalein. This is very misleading to the layman, who does not realize that while the boiler may actually be alkaline, there is a corrosive condition existing. This is more true of nitrate of lime, which on concentration shows decidedly alkaline, as compared with nitrate of magnesium, the reaction of which is almost neutral.

Corrosion Due to Decomposition of Organic Compounds in High Temperature Boiler Reactions

With high steam pressures and high superheats now in extensive use, cast-iron economizers are no longer considered safe, and when steel economizers are employed the corrosion is often accelerated. To relieve this condition there is now being marketed an air-separation process for the removal of dissolved gases, including the objectionable oxygen and carbonic acid. If the hypothesis be true that corrosion is the effect of the hydrogen ion on the iron metal and that the oxygen dissolved in the water reacts upon the nascent hydrogen liberated, then the removal of these objectionable gases should solve the difficulty.

The advocates of this process recommend that it be used in preference to distillation, but in this case, of course, the hardness of the water still would have to be dealt with by the addition of chemicals. Furthermore, the author has seen waters apparently free from both free and half-bound carbonic acid which produce CO_2 from the disintegration of organic compounds in high temperature boiler reactions. In most cases, however, if the temperature of the feed-water is held at about 200° F. the dissolved gases are driven off sufficiently to make it possible to treat the corrosive properties chemically.

The correct condition for water in a boiler is an alkaline reaction toward both phenolphthalein and methyl orange. The question as to the concentration of soda ash under the influence of boiler pressure and the degree of alkalinity maintained has created a field for most attractive research. As already stated, water softened by zeolites almost invariably contains free sodium carbonate; also water from all softening systems contains sodium carbonate, and by the constant evaporation of water it is an easy matter to figure theoretically and practically the number of grains per gallon present at the end of any definite period.

In the fall of 1915 the author was called upon to treat water in four boilers in a textile mill near Wayne Junction. These boilers were of the return tubular type, approximately 150 hp. each, and the supply was a mixture of Schuylkill River water furnished by the city and varying amounts of well water of about 9 grains per gallon hardness. The feed-water heater was of the closed type and the small amount of temporary hardness present was practically entirely eliminated before entering the boilers. The particular treatment called for no caustic soda but considerable amounts of soda ash and phosphates as lime precipitants. The boilers operated at about 110 lb. pressure and to the author's surprise an examination of the water at the end of two weeks' operation showed the presence of free caustic soda.

Decomposition of Sodium Carbonate

It is general knowledge that at red heat sodium carbonate in the presence of a current of superheated steam is converted into caustic, and assuming this to be 1,500° F., it is a temperature evidently greatly in excess of any temperatures in an operating boiler. Nevertheless, from work done at this and other plants, it has become evident that with the rise of temperatures as produced by increasing boiler pressures, increasing amounts of sodium carbonate are converted into caustic soda with free carbonic acid, and in the case of condensing units this would be returned again and again to the boilers.

On the assumption that carbonic acid would be found in the condensate water, an analysis would show at about 60° F. approximately 4,500 cc. of gas per gallon of condensate, whereas the author's experience in numerous samples has ranged from 50 to 95 cc. as a high figure. The thought suggests itself that perhaps the gas had been removed with the air from the air-pump discharge, but since dissolved carbonic acid is not readily liberated until its saturation point, and further, since the condensate water is always saturated with oxygen, that cannot be the case.

Of the two possible combinations of carbon with oxygen, CO_2 and CO, the former combines with alkalis to form carbonates and the latter to form formates, and just as red ferric oxide can be reduced to black ferrous oxide, so carbon dioxide can be reduced to carbon monoxide and its salts from carbonates to formates. These combinations may be represented by the following equations:

$$Na_2CO_3 + H_2O = \underset{\text{(sodium formate)}}{NaCHO_2} + NaOH + O$$

$$2NaCHO_2 + H_2O = \underset{\text{(sodium acetate)}}{NaC_2H_3O_2} + NaOH + O$$

$$NaC_2H_3O_2 + NaCHO_2 = \underset{\text{(acetaldehyde)}}{C_2H_4O} + Na_2CO_3$$

In the presence of formate of soda the purple color of permanganate might be expected to be destroyed if added to a sample of boiling water, and by actual test that is exactly what happens.

Soda ash or sodium carbonate, which are not oxidizing agents under normal laboratory conditions, evidently under boiler pressures assume such a role and degenerate into sodium formate and free caustic soda.

It is possible to go further into the theory and show that, at about 400° F., two molecules of sodium formate water can degenerate, with the elimination of oxygen and the production of caustic soda and sodium acetate. Further, a possible reaction is the combination of the acetate and formate with the reformation of soda carbonate, and the production of acetaldehyde. This new substance is volatile and the rest of it may polymerize into complicated organic compounds, which, acted upon by the free caustic soda, blacken scale formations.

We are all still in the field of intelligent experimentation as to just what is occurring under boiler conditions, but it may be stated with certainty that caustic soda can invariably be found, free oxygen liberated, and at least some formaldehyde produced wherever sodium carbonate exists under a steam pressure greater than 100 lb.

Effect of Caustic Soda Produced by Decomposition of Soda Ash Under Boiler Pressure

With definite evidence then in hand that caustic soda is produced through the decomposition of soda ash, we are now in a position to consider the effect of such caustic soda, and similarly, of course, the effect of caustic soda when added directly as feed-water treatment.

In 1912 a certain boiler distress occurred at the University of Illinois which was investigated by Prof. Samuel W. Parr of that university. The water in question at Urbana, Ill., was unique in character in that it was almost free from sulphates and had from 60 to 70 parts per million of free sodium carbonate. The boiler distress showed first in the form of fine cracks which developed and proceeded either from rivet holes to the surrounding plate, or from rivet hole to rivet hole, or from rivet holes to the edge of the plate where there is no tensile stress whatever. It is interesting to note that these cracks always occurred below the water line and always in conjunction with a leak or other condition, which promoted the concentration of soluble material to the saturation point. The general conclusions arrived at by Professor Parr and his associates were as follows:

1. Caustic soda of sufficient strength attacks iron with the generation of hydrogen.

2. Hydrogen in the nascent state, whether generated by alkali or acid, enters into the texture of the iron in a way to modify its physical properties.

3. The hydrogen effect, at least in its first application, is transient, and after a period of rest or freedom from the hydrogen action, the iron reverts to its normal condition.

4. Sodium carbonate is without action on iron; there is, therefore, no generation of hydrogen. The hydrolysis of sodium carbonate is directly dependent upon the temperature maintained, the withdrawal of the vapor of CO_2, and the admission through the feed-water of carbonated water. It is evident, therefore, that the chemical activity would vary with the ratio of hydrolization or the degree of concentration of the sodium hydroxide.

5. Certain accompanying salts, as the chromates, have an inhibitive effect. Other salts, as sulphates, have at least the effect of acting as diluents. The limits of concentration for maintaining a condition which would be below the danger point have not been studied, but are the features of the case which are of the utmost importance. A continuation of experiments along the lines suggested is in progress.

To say just where the concentration of soda ash and consequently caustic soda becomes dangerous would be impossible. There are no definite limits which can be placed since the presence of other salts, sulphates and chloride of sodium, etc., have an inhibitive effect. Consequently larger amounts of soda ash may exist safely in a boiler, in so far as the action on iron is concerned, when the amount of sodium sulphate is larger.

The question of excessive soda ash must always be considered in a conjunction with a zeolite softener when the feed-water contains high temporary hardness. It will be recalled that this temporary hardness is converted into sodium carbonate by the action of the zeolite and proceeds to concentrate in the boilers. It is indeed highly advisable that in plants where zeolites are used the concentration of water be tested at frequent intervals and the boilers drained and refilled with fresh water at such times as in the opinion of an expert this should be done. This concentration proceeds differently at different seasons of the year with the fluctuation of the raw water and the varying percentages of condensate and make-up always present in industrial plants from season to season.

Personal Items

Dr. Ernest Fox Nichols, who recently resigned the presidency of the Massachusetts Institute of Technology, will resume the directorship of pure science in the Nela Research Laboratory of the National Lamp Works of the General Electrical Co., Cleveland, Ohio.

* * *

R. C. Wells, chemist on the staff of the U. S. Geological Survey, was elected president of the Chemical Society of Washington at the meeting of the organization Jan. 12, at the Cosmos Club. J. B. Reed, of the Bureau of Chemistry, Department of Agriculture, was elected secretary, and H. W. Houghton, of the Hygienic Laboratory, U. S. Public Health Service, treasurer.

* * *

A. P. Van Gelder, general superintendent of high explosives plants, Hercules Powder Co., after many years' service in explosive manufacturing, announces his retirement, effective Jan. 1. Resulting changes in administration personnel comprise the appointment of L. N. Bent as assistant general manager in charge of miscellaneous manufacturing and of C. A. Bigelow as assistant general manager in charge of high explosives manufacture. F. P. H. Sholly has been transferred from the operating to the purchasing department to serve as assistant purchasing agent. Messrs. Bigelow and Sholly are accessions to the Hercules organization from the recently acquired Aetna Explosive Co., Inc.

Personal Items

Louis E. Saunders has been appointed director of the research department, Norton Co., Worcester, Mass.

* * *

Robert E. Devine, formerly with the Joslin-Schmidt Co., Cincinnati, Ohio, is now with the Armour Soap Works, Chicago, Ills.

* * *

John T. Harris, of the Allbright-Nell Co., Chicago, Ills., is now located at 829 N. Y. Life Bldg., Kansas City, Mo., as its southwestern representative.

* * *

Fuller Clarkson, formerly with the Fixed Nitrogen Research Laboratory, Washington, D. C., is now with the Proctor & Gamble Co., at its Ivorydale, Ohio, plant.

* * *

W. S. Mahlie, formerly with the Buckeye Steel Castings Co., Columbus, Ohio, is now chemist and bacteriologist for the city of Fort Worth, Texas.

* * *

L. J. Baney has resigned from the Chemical Warfare Service, Edgewood Arsenal, Md., to accept the position of superintendent, Biggs Chemical Co., Amherst, Ohio.

* * *

Dr. H. H. Morris, formerly in the chemical department, E. I. du Pont de Nemours & Co., is now director of the research department, Bond Mfg. Corp., Wilmington, Del.

* * *

Dr. Jerome Alexander and Walter Alexander are respectively president and vice-president of the Uniform Adhesive Co., whose new plant at the Bush Terminal, Brooklyn, N. Y., is now in operation.

* * *

E. W. Rice, Jr., president, General Electric Company, has been elected to honorary membership in the Tau Beta Pi society, a national honorary engineering society in the engineering colleges of the country.

* * *

W. B. Martin, formerly purchasing agent and traffic manager, paint and varnish departments, Ault & Wiborg Co., Cincinnati, Ohio, is now with Isaac Winkler & Bros., of that city, distributors of heavy chemicals.

* * *

Mason Harker, secretary, American Glycerine Producers' Association, has left for a 2-months' trip to Europe where he will take up with British and continental producers the standardization of the product and packages.

* * *

C. L. Bryden, formerly chief engineer, Kelly Filter Press Co., and well known as a filtration engineer, has been appointed eastern representative of the Vallez Rotary Filter Press Co., with headquarters at 95 Liberty St., New York.

* * *

Dr. Edward Plaut, since 1915 vice-president of Lehn & Fink, Inc., wholesale druggists, New York City, has been elected president to succeed his uncle, Joseph Plaut, who becomes chairman of the board. Dr. Plaut is a Princeton man who obtained his doctorate from Columbia University.

* * *

Dr. E. W. Dean, long connected with the Bureau of Mines as petroleum technologist, has resigned to accept the position of assistant to Roger Chew, inspection department, Standard Oil Co. of New Jersey. He will be succeeded in his position at the Pittsburgh station by N. A. C. Smith of the Washington, D. C., laboratory. F. W. Lane, organic chemist at Pittsburgh, will succeed Mr. Smith.

* * *

L. E. Calkins and F. Schilling have been transferred from the superintendencies of the Minneapolis and St. Louis plants, respectively, of the Barrett Co. to the Chicago organization. A. Pacyna, of the production staff at Chicago, has been transferred to the Shadyside, N. J., research staff.

* * *

At the recent annual meeting of the Perfumery, Soap and Extract Association of Chicago, the following officers were elected: President, E. J. Voss, Graham Bros. Soap Co.; vice-president, W. J. King, of Mme. Ise'bell's Toilet Mfg. Co.; secretary-treasurer, W. L. Filmer, Monsanto Chemical Works.

* * *

Arthur W. Gates, chief dyer of the plants of the American Thread Co. and overseer of the company's dye and bleach house at Willimantic, Conn., is to devote all of his time in the future to his duties as chief dyer for the corporation. E. J. Moriarity, assistant overseer of the Willimantic dyehouse, will succeed Mr. Gates as overseer, while Walter Jones is advanced to the place formerly held by Mr. Moriarity.

* * *

Thomas M. Rector has resigned as director of the Department of Chemistry of the Pease Laboratories, Inc., 39 W. 38th St., New York, to take over the management of the newly organized Rector-Tenney Co., 14 Church St., New York. This company has been organized to develop certain inventions of Mr. D. Tenney, chief engineer, the Franklin Baker Co., and Mr. Rector, relating chiefly to the preservation of food and kindred products.

* * *

Dr. H. W. Dye has resigned his position as assistant professor of plant pathology, Cornell University, to become chief pathologist of the Research Department, Dosch Chemical Co., Louisville, Ky., manufacturers of insecticide materials and appliances. Dr. G. E. Sanders also joins the Research Department of this company as entomologist, having resigned his position as chief of Insecticide Investigations of the Canadian Department of Agriculture.

* * *

F. S. Dickson, chief of the Drug and Chemical Control Section of the Customs Service, Washington, D. C., which handles licenses for the importation of dyestuffs and chemicals, is considering the appointment of a chemical advisory committee. Mr. Dickson has in mind the appointment of such a committee to be composed of Government chemists who will advice in decisions as to whether or not a commodity is a synthetic under the drug and chemical control act.

* * *

Dr. A. V. H. Mory, engaged in consulting practice in Chicago, has been appointed director of the Technical Bureau of the Biscuit and Cracker Manufacturers' Association, with offices at 634 Hearst Bldg., Chicago. The Technical Bureau was organized in 1919 to conduct research in this department of the baking industry to insure improvements in the quality and uniformity of the Association's products. The appointment of Dr. Mory as administrator insures the cordial collaboration of all technical men in the industry which in itself offers great possibilities for constructive work.

Industrial Notes

The Viscoloid Co., celluloid products, Leominster, Mass., will build a two story 40 x 50 plant addition.

* * *

The Frost Insecticide Co., Arlington, Mass., will build a new plant unit costing, with equipment, $50,000.

* * *

Piel Bros. Starch Co., Indianapolis, Ind., will construct an additional story to its 200x200 plant costing $50,000.

* * *

The Viscose Co., will build a 3-story and basement addition to its Marcus Hook, Pa., plant, costing about $150,000.

* * *

The Du Pont Fibre Silk Co., with plant at Tonawanda, N. Y., will increase its capital stock from $10,000,000 to $12,500,000.

* * *

The General Ceramics Co., 50 Church Street, New York, will spend $100,000 in the enlargement of its plant at Metuchen, N. J., for the production of sanitary ware.

* * *

The California Gypsum Co., Los Angeles, has applied for a lease of property at National City, Cal., as as site for a new plant, estimated to cost $250,0000, including machinery.

* * *

The Nickle Engineering Works, Saginaw, Mich., manufacturers of agitator equipment for chemical tanks, has leased a portion of the Schemm Brewing Co. plant of that city for machine shop purposes.

* * *

The Dairymen's Cooperative Association, Inc., main office Utica, N. Y., has purchased 12 of the New York State milk plants of the Nestle's Food Co., including a large condensary at Cooperstown, N. Y.

* * *

The National Aniline & Chemical Co. has acquired The Heyl Laboratories, Inc., 437 Barretto Street, Bronx, New York City, manufacturers of biologicals, bacteriological stains and acridine antiseptics.

* * *

The Ultra-Marine Co., Huntington, W. Va., has plans under way for the erection of a new one and two-story plant at Cincinnati, Ohio. Bids will be asked in February. E. C. Baugher is superintendent.

* * *

The Raritan Copper Works, Perth Amboy, N. J., is perfecting plans for the manufacture of copper gutters, leaders, shingles and kindred specialties, and will soon commence the installation of machinery for this department.

* * *

The Hamilton Tar & Ammonia Co., Hamilton, Ont., will build a factory and warehouse to cost $50,000 at Ottawa, Ont. W. M. Currie, president of the company, will receive bids for tar stills and all equipment including tanks, etc.

* * *

The Guarantee Construction Company, 140 Cedar Street, New York, have been awarded the contract for the seed handling and conveying equipment of the Archer-Daniels Linseed Company's plant in course of construction at Edgewater, New Jersey.

* * *

The Coca-Cola Co., Atlanta, Ga., plans to build a plant in Boston, increasing its number to 14 throughout the United States and in Cuba and Canada. It proposes to introduce economics by purchasing raw sugar and refining it for syrup, instead of buying granulated sugar.

* * *

The Texas Co. plans to distribute its sulphur property, after development to commercial production, as a stock dividend during 1922. This property, located at Hoskin's Mound, Brazoria Co., Texas, embraces 28,000 acres and is claimed by experts to cover one of the largest proven bodies of sulphur. Investigations during the past three years disclosed at depths of 1,000-1,200 feet a sulphur-bearing stratum of 70-100 feet in thickness.

* * *

Colgate & Co., Jersey City, N. J., has acquired manufacturing property at Montreal, Canada, which, subject to slight alterations, will be devoted to the supply and development of its Canadian business. The company also has awarded to the Turner Construction Co., New York City, contract for the erection of a three-story 100x125 addition to its Jersey City plant, costing about $140,000.

* * *

The new plant of the Corn Products Refining Co., at Argo, Ill., costing about $1,500,000 for the manufacture of dextrose of a high degree of purity represents the commercial consummation of investigation, undertaken by the Bureau of Standards wherein by the enterprise of the Bureau a new industry of great potentialities virtually has been created. The methods and machinery used in the manufacture of granulated sugar are largely utilized, with the result that the dextrose crystallizes out in beautiful small white crystals.

* * *

The Pabst Corporation, Milwaukee, Wis., formerly the Pabst Brewing Co., has reorganized its official personnel, with Frederick Pabst as president, to succeed Col. Gustave Pabst; Harry W. Marsh, formerly secretary, as vice-president and general manager; Hugo Kuechenmeister, treasurer, and Edward F. Loebl, secretary. Besides continuing the manufacture of malt syrups, cereals, etc., the new administration has plans for converting some of the unusued capacity into metal-working industries, the first to be a machine shop for producing a patented design of valve rotator for internal combustion proppet-valve engines. A small experimental shop has been operated on this design for about 18 months.

POSITION WANTED

GRADUATE Chemical Engineer, ten years' practical experience in design, construction and maintenance work with several large concerns, now available. Steady, clean-cut, ambitious. I will be glad to have you check up my work. Address: L. E., care of CHEMICAL AGE.

BUSINESS OPPORTUNITY

WANTED—A man who is thoroughly experienced in the manufacture of wood chemicals, wood alcohol, etc., to organize a chemical company for the manufacture of hard wood chemicals. Every encouragement and financial assistance, together with location of the plant, will be afforded by a corporation in central West Virginia, which owns twenty-five thousand acres of hard wood. Great shipping facilities via Baltimore & Ohio Railroad. Address "Chemical Plant," care of CHEMICAL AGE.

CHEMICAL
AGE

A CONSOLIDATION of THE CHEMICAL ENGINEER and CHEMICAL AGE
LLOYD LAMBORN, *Editor*

VOLUME 30 NEW YORK, FEBRUARY, 1922 NUMBER 2

Some Basic Considerations of American Business

By Joseph French Johnson

Dean, New York University School of Commerce, Accounts and Finance; President, Alexander Hamilton Institute

CHEMISTS engaged, as they are, in intimate contact with the technical problems of production naturally have a vital interest in all that affects the sale of goods, activity in which determines directly the volume of output, the measure of employment and hence the applicability to plant practice of many plans to reduce production costs.

JOSEPH FRENCH JOHNSON
Dean, New York University School of Commerce, Accounts and Finance; President, Alexander Hamilton Institute

No discussion of American business and its outlook can fail to touch on many conditions which are sadly familiar to every business man. Business in America faces a multitude of "ifs." They stand in front of the business man like little devils and he really does not know which way the imps are going to leap.

The great war left us a heritage of huge bonded debt and, worse still, a high level of prices, from the crest of which during the last eighteen months the country has made a disastrous plunge. Wages in some industries have fallen, but in many important industries, notably in the building trades and on the railroads, labor unions are still clamorous for the inflated pay envelope of war times. If labor is going to make a long and bitter fight against any reduction of wages, then there can be no adjustment of costs of production to market prices and no early return of prosperity for American business.

Present Conditions the Offspring of Ignorance

This country went through a long period of hard times after the Civil War. After the Napoleonic wars Europe was prostrate, and short-sighted prophets made the same gloomy predictions about the collapse of civilization which we read today in newspapers and magazines. But war was not the cause of depression then, nor is the recent war the real cause of our present depression.

The real cause lay in our own ignorance. All the belligerents, including the United States, financed the war in the old-fashioned, barbarous fashion, namely, by an unparalleled inflation of the medium of exchange. Europe printed tons of paper money and the United States brought on an almost equal inflation by an enormous expansion of bank credit based on the large mass of gold which Europe sent us in payment for war supplies.

With a million of our boys in Europe, many suffering untold hardship, a great national emergency was capitalized by every human element in production with the result that at the end of the war we found ourselves saddled with a debt the size of which would have been declared crushing ten years ago.

We hope there never will be another war, but if this country ever is forced into a war with an enemy anywhere near its own size it is to be hoped that we shall be ready with a scientific financial plan, so that our full economic strength can be brought to bear upon the enemy.

I will not undertake to describe such a scientific financial plan, but I feel pretty confident that its outstanding feature will be universal conscription; that Uncle Sam will put his hand upon the shoulder of every man and woman and say, "I want you," and that the men who stay at home will have no larger income than those who go to the trenches.

A war financed in some such fashion would give us no inflated currency, no spectacular rise of prices, no profiteering, and its aftermath would be, not a huge bonded indebtedness, business depression and unemployment, but joy that the infernal thing was over and a prompt return to the profitable industries of peace, for production costs and market prices would not be out of adjustment. If the world knew that the United States proposed to finance its next war in this manner, I feel confident that we would never be forced into another war, for no nation or group of nations would be rash enough to attack us.

Foreign Trade and Its Importance

Foreign trade is a subject about which many people have very hazy ideas. During the war our exports mounted to large figures and many people predicted a great commercial future for the United States. On account of these predictions young men flocked in great numbers to our schools of commerce and enrolled in courses intended to equip them for the solution of problems that confront exporters and importers. But the expected expansion of our foreign trade has not materialized and probably will not.

We cannot have billions of exports unless we have equal billions of imports, and for the latter the American people are not eager. To prove this a single illustration should suffice. European governments owe the United States some eleven billion dollars. Suppose we insist upon the payment of interest, say, five hundred million dollars a year. Let us assume that England finances the payment. The interest must be paid in gold or in dollar credits convertible into gold. Suppose that the first payment will amount to one hundred million dollars and will be due March 15, 1922.

Since the debtor nations have not the gold and could not spare it if they had it, England must begin to purchase the gold or the dollars. She goes into the world's market and offers her pound sterling in exchange for gold or dollar credits. She can buy dollar credits only from nations which have exported goods to us, and if enough credits cannot be found in that way she will be forced to offer her pound sterling at a discount.

Suppose the pound valued in dollars falls from \$4.00 to \$3.75. That would mean no changes of prices in the English markets nor in any of the world's markets where the pound sterling is acceptable to exporters. But it would have great significance for us Americans, for the foreign goods which had formerly cost us \$4.00 would then cost us only \$3.75. Naturally, American people would increase their consumption of foreign goods and you would read bitter editorials in our newspapers about our having become the dumping ground for the products of the cheap labor of Europe, and some editors, I fancy, would discover that there was a conspiracy in Europe to destroy American industries.

America cannot collect the interest or the principal of that allied debt at the present time without great injury to her own industries. The United States became a creditor nation in a few years as a result of a world cataclysm. It took England over one hundred years to become a creditor nation and her industries were gradually adjusted to the inevitable changes in the relative volume of exports and imports, so that an excess of imports was welcomed by her people, just as in this country we have beheld with joy any increase in our exports.

Cancellation of War Indebtedness

It is proposed that we should voluntarily cancel the allied indebtedness, not merely because it is practically impossible for the allies to pay that debt without injuring our own industries, but also because the money we loaned the allies was all expended for supplies in this country, which we sold them at high prices, and was expended in a war in which we later discovered ourselves to be as greatly interested as were the allies. Whether we decide to cancel the debt or not—and that is a decision that must be made by the creditor and not by the debtor—this subject is one to which American business men should give careful consideration.

Personally I like the suggestion of Mr. Frank A. Vanderlip, formerly president of the National City Bank. In an address to the New York Economic Club, after picturing the economic distress and financial misery now prevailing in Europe, he suggested that the United States say something like this to its European debtors:

> "We know you cannot pay your debt to us now and that for a few years you will not be able to pay us all the interest. Give us what you can each year and we will invest it as best we can in the needy countries of middle Europe and help them re-establish their civilization financially, industrially and educationally. This will all redound to your benefit, for you cannot prosper if half of Europe sinks into pauperism and barbarism. In the years to come, when Europe is restored, we will discuss this debt with you and the means and methods of payment."

Some critics have called Mr. Vanderlip's plan impracticable, and it doubtless seems so to many, but I ask you to remember that all our ideals seem impracticable when they are first born. George Washington, Alexander Hamilton, Benjamin Franklin and the rest of those sturdy fathers were thought by many to be impractical idealists when they planned to take thirteen discordant, independent colonies, with their different environments, customs and prejudices, and weld them into one great united nation. All great achievements from the beginning of time have been built up on ideals which the common man at first regarded as impracticable.

Our Surplus Production

The importance of foreign trade is not to be found in any difference between exports and imports. That fallacy, over three hundred years old, still persists, for a prominent business man, in a recent article, seeks to prove that foreign trade is of small importance as compared with domestic trade, because our total profits from foreign trade in 1920 were only three billion dollars, whereas our profits from domestic trade probably exceeded one hundred billion dollars. What he calls the profits of our foreign trade is simply the excess of the exports over the imports of merchandise. The absurdity of such a conclusion seems obvious, for certainly no individual would think himself prosperous because his receipts were less than his expenditures.

Trade between the United States and foreign nations is profitable for the same reason that trade between Pennsylvania and Illinois is profitable, and both parties to the trade, if both are honorable and intelligent, make a profit. The United States needs a foreign outlet for some of its raw materials and for many of the products of its inventive genius. If, for example, there were no foreign market for any part of our cotton crop, then the southern planter would adjust himself to the situation and produce no more cotton than he could sell at a profit in the United States. The foreign market in normal times enables him to produce a crop far in excess of the domestic needs and so helps to enrich the people of the cotton belt. The people of the United States, if necessary, could support themselves in tolerable comfort without the aid of foreign trade. But they would have to get on without many things they now deem essential. The United States is undoubtedly better situated than any other nation for the trial of such an experiment, for its resources are rich and varied.

German Currency Inflation

Germany's experience since the armistice illustrates in a curious way some of the evils of an inconvertible paper currency. The printing press has turned out so many billions of paper money that the mark, formerly worth about 24c, has declined to a fraction of a cent. In spite of this great depreciation the prices of commodities and services in Germany have not risen in a corresponding degree. Consequently, an American visitor in Germany finds himself able to buy with a dollar's worth of marks two or three times as much as he could buy in any other country. German manufacturers are prosperous, for the wages of all kinds of labor, measured in gold, are far below the wages paid in other countries. In foreign countries, therefore, Germany at the present time has a great advantage and is able to undersell competitiors. Yet the domestic situation in Germany is abnormal and cannot long continue.

The reason why the German mark as currency in Germany is worth more with respect to goods and services than it is with respect to gold or American dollars is a very curious one. Only part of the paper marks which have been issued in Germany are in circulation in that country, for a large part of them lie in the strong boxes of investors in other countries. Many people in the United States during the last two years, being confident that Germany would sooner or later recover and redeem her mark, have invested their savings in them and have had the painful experience of seeing them decline from eight cents to less than a cent.

The money which the German Government realized from these sales of paper marks to investors undoubtedly helped her to make the first reparation payment of the indemnity; and, as you can readily see, the maintenance in Germany of a comparatively low level for prices and wages has given Germany a great advantage in foreign trade. This advantage is bound to be temporary, for labor leaders in Germany will soon understand the situation and refuse longer to let their men work for the equivalent of sixty or seventy cents a day.

Domestic Conditions

The immediate future of American business depends very much upon what the course of prices will be. There are reasons for believing that the present price level will not be materially changed for several years. Prices on the average are now about 60 per cent above the prices of 1913. Our gold stock is double what it was ten years ago, and the credit facilities of our banks, thanks to our Federal Reserve system, are more than doubled.

The general level of prices in any country is determined by the available volume of money and credit. We have an abundance of both. Indeed, the banks have credit far beyond their requirements. For these reasons I feel safe in predicting that American business will steadily improve during the next twelve months.

The rate of progress will be determined by the measure of cooperation on the part of every element of our citizenship and the degree to which they will promote the common interest by submerging every form of class aggrandizement which not only is at the expense of all of us but futile of advantage to the class.

Universal Calculating Machine for Chemical Calculations

By C. A. Jacobson, Ph.D.
Professor of Chemistry, West Virginia University

C. A. Jacobson, Ph.D.

I PRESENTED this subject before the Faculty Science Association of the West Virginia University at its January meeting, and desire through CHEMICAL AGE to invite a more extended consideration of the possibilities of a mechanical calculating device whose accuracy and field of use surpass that of any similar machine.

The Slide Rule

This machine has been constructed on the well-established mathematical principles which govern the operations of the slide rule. As a labor-saving device the slide rule has well nigh revolutionized the sciences, but its scope is limited and the degree of accuracy obtained is too small for refined work. Thousands of computations are possible with my machine that could not be carried out on the slide rule, unless factors for the same were obtained from tables or worked out mathematically.

The ordinary slide rule has a scale ten inches long. In other words, this distance is divided up into the logarithmic distances from one to ten. Instead of ruling these distances on a ten-inch scale, I have ruled them on a scale 328 feet long (10,000 centimeters to be exact), making this machine 400 times more accurate than the slide rule, besides providing a factor board of white celluloid, whereon over 5,000 factors in all sorts of computations are printed in plain view of the operator of the machine.

It would obviously be impossible to construct or operate a straight rule 328 feet long; consequently, a scale of this length has been ruled in the form of a spiral band or helix on each of two mechanically operated drums, which are only a foot in diameter. The calibrated spiral scale on one of the drums serves as the "slide" and the other as the coordinated "rule."

The Universal Calculating Machine
Construction and Operation

My machine is a mechanical device that multiplies, divides, extracts roots, raises numbers to any power, gives at a glance twelve different functions of any angle which may be brought directly into computations, as well as computes the analyses of over 3,000 chemical determinations, and may equally well be employed in surveying, astronomy, mathematics, physics, engineering, banking, or any phase of human knowledge where factors can enter into calculations.

The machine is composed of two movable drums mounted upon axes. These are controlled by a geared mechanism, in such a way that the machine will give the answer to some of the most difficult computations in a few seconds of time, by three or four slight movements of the drums, and the answer will be corect to six decimal places.

These drums or cylinders are movable on the shafts, but may be clamped to the shafts at any desired point by means of brake-shoes operated from the ends of the drums by thumb screws. When so clamped the drums may be turned in unison by a geared mechanism, and the fine adjustments made by a micrometer screw engaging one of the larger gear wheels. In this way the relative position, with respect to the index of two points on the two scales will not be altered when the drums are rotated, for after the drums have made a complete revolution the two points will come into coincidence with one another again. Any given number on one scale may be brought into coincidence with any other number on the oposite scale, by means of a celluloid-headed duplex pointer moving in a channelled bar or guideway, located equi-distant between the drums, and operated by a thumb screw. There are two of these pointers, one operated from each end of the machine.

Various other mathematical functions could be ruled on these drums, as well as the printing of hundreds of chemical formulae, symbols, characters, etc., representing numerical values entering into computations, for there is a distance of 328 feet upon which these may be spread out.

The machine is not large or clumsy. The working mechanism is mounted on an attractive steel frame, the legs of which are supplied with casters. The operator sits up to the machine as to a typewriter, pulls up the roll top, which protects the working mechanism from dust, and adjusts the drums by means of hand wheels, like that on a sewing machine. The two pointers are moved horizontally with the drums by means of thumb screws as already explained.

Examples of Its Work

As examples of carrying out calculations on this machine let us say that we want to multiply 8467 by 378. Set the right pointer on the lower drum at 8467, which is shown in large divisions on the scale. Turn the upper drum so that the other end of this pointer shows 378, and clamp the drums on the shafts as already described. The shafts and drums are then rotated in unison until the left index (or end of the scale) of the upper drum appears, when the left pointer is adjusted so that its hair line falls upon this index. The hair line of the lower end of this pointer gives the reading 320053. Division is just as simple as this. The only difference is that the index of one scale is set on the dividend, and the other pointer set on the divisor, when the quotient is read from the other end of this pointer.

If, for example, we are standardizing a sulfuric acid solution, and have precipitated a given volume of it with barium chloride and have weighed the resulting barium sulfate. Set the right pointer to correspond with this weight on the lower drum, and the upper end on the number 1,200, which is the factor for barium sulfate to sulfuric acid, found on the factor board. The upper end of the left pointer is placed upon the index, when the lower end of the pointer shows the weight of sulfuric acid desired. To arrive at this result there have been one setting on the lower drum and two settings on the upper, requiring about twenty seconds of time. The same result could have been attained by setting the pointers on the formulae representing these substances, which are found printed on the scales, in the same manner that the chemists' slide rule operates, but this would involve one more setting of the machine.

To raise a number to a given power, multiply its logarithm, which is the actual distance on the scale from the unity index and is read directly on the drum, by the number of the power. To extract roots, divide the logarithm of the number by the power of the root. For carrying out trigonometric computations the spiral scale on the lower drum is ruled in red ink corresponding to natural sines. The log sines are shown by the black lines where a given angle is marked. Cosines and log cosines may be obtained from the opposite index of this drum. Tangents and cotangents are shown by green lines on the lower drum, while secants and cosecants are given by blue lines on the upper drum. These functions are brought into computations in a similar manner to that described above.

Commendation of the Machine— Its Dedication to Industry

This computing device was patented during the war but nothing has been done till now to bring it into public notice. Eminent mathematicians and physicists who have examined the construction of this machine agree that the principles governing it are mathematically and mechanically sound.

What remains to make the device a factor in human progress is to enlist sufficient capital and technical skill to develop the machine on a commercial basis. In order to get this accomplished I would be willing to relinquish practically all pecuniary interest in it. I shall be amply rewarded when I can hear that it is actually in use in thousands of offices throughout the country.

New Jersey Chemical Society

In the absence of President Ralph G. Wright, director, department of chemistry, Rutgers College, New Brunswick, N. J., Vice-president Charles P. Titus, consulting microscopist, presided at the February meeting of the New Jersey Chemical Society at Stetter's restaurant, Newark, on the 13th inst.

Prof. Wright's absence arose from his attendance upon the annual banquet of the New Brunswick Board of Trade, of which body he is president. Such participation by a teacher of chemistry in the civic and industrial affairs of his community is noteworthy, which fact is a commentary on the backwardness of chemists as a class to mix among people of their communities and to engage as citizens in matters of common interest.

Dr. Harlan S. Miner, chief chemist, Welsbach Light Co., has the local distinction of the presidency of the Gloucester, N. J., board of education.

It would be interesting to learn to what degree chemists, wherever they may lodge, are living up to their responsibilities as citizens. What is there in the ordinary chemically educated man's make-up that makes him furtive, ill-at-ease and out-of-place among men whose social outlook is broader than the plant? It is simply the lack of exercise of qualities, bound for atrophy, and whose development are essential to the man's progress.

Herein lies the charm of the New Jersey Chemical Society. It is dedicated to helping the young man make the most out of himself and can succeed only to the degree that the young man cooperates.

Dr. Arthur E. Hill, professor of physical chemistry, New York University, and a former Newark boy, told of his investigation of the properties of silver perchlorate.

Robert H. McCready, publisher of CHEMICAL AGE, related his observations on a recent trip through Germany and the application of his deductions to American industry. Fourteen new members were admitted.

Preservation of Milk for Beverage Use

THE impetus to grape culture and raisin production, contrary to pessimistic anticipations, has been one of the notable reactions of prohibition legislation. A more wholesome by-product of this type of social control is the attention given to milk as a commercial proposition in the promotion of its beverage use. The difficulties of its preservation arising from the conditions of its production and distribution have been the chief obstacle in the most desirable extension of use of what has been called a complete and perfect food.

Methods of preservation in use do not prolong the period during which the milk is salable as food beyond a few days. It is obvious that a commercially practicable treatment of milk that will permit its handling in a manner common to all beverage commodities would be an industrial innovation of profound economic influence. Clarence L. Arnoldi, of Manitowac, Wis., has devised a means* whereby the milk so preserved may be dispensed either as an attractive effervescent carbonated beverage, or as an ordinary quantity of fresh milk, substantially in the condition that it would be delivered by a milkman when less than twenty-four hours old.

Heretofore attempts have been made to preserve milk by charging it with carbon dioxide gas, CO_2. In some of these preserving methods the natural flavor of the milk is largely destroyed by overheating or other preliminary sterilization. In other instances it has been attempted to partially sterilize the milk by passing carbonic acid gas through it, thereby reducing the acidity produced by bacterial agents of decomposition to such an extent as to prolong the period during which the milk will remain fresh under the conditions in which milk is ordinarily handled.

Mr. Arnoldi has discovered that it is possible to subject milk to a preliminary treatment for the removal of foreign flavors and gases without in any way injuriously affecting, or substantially altering the quality of milk, and that when the milk has been thus treated it may be heavily charged with carbonic acid gas under pressure, and confined in sealed containers while under such pressure, whereupon it may be stored and kept in its natural condition for long periods of time, i. e., for weeks, and even months, dependent, to some extent, upon temperature conditions, but principally dependent upon a strict conformity to his process, which will now be described in detail.

Procedure

The milk is first subjected to agitation under substantially twenty inches of vacuum at a temperature corresponding closely to the body heat of the animal from which the milk is derived, i. e., at a temperature ranging from 95° F. to approximately 101° F. The agitation will be continued, and this temperature maintained under ordinary conditions for about five or ten minutes, after which it is promptly cooled nearly to the freezing point of water, preferably to a temperature somewhat below 40° F., but not sufficiently low to allow the water in the milk to freeze.

If the milk is more than ordinarily free from foreign flavors and gases, the period of agitation above referred to may be materially shortened, and in some instances it may be cooled immediately after receiving it from the producer to a temperature below 40° F., and it may then be subjected to the vacuum treatment, preferably with agitation while at such temperature, after which the temperature may again be reduced, if necessary, in order to bring it below 40° F., preparatory to carbonating it.

In either case, after the milk has been subjected to the vacuum treatment, it is carbonated at a pressure of about sixty pounds to the inch. Either the so-called continuous or the batch carbonation process may be followed; both of which methods of charging liquids with carbonic acid gas are well known. After the milk has been thoroughly charged with CO_2 it is transferred immediately into kegs, cans, bottles, or other suitable containers while maintaining the pressure, and the containers are thereupon sealed hermetically to prevent the gas from escaping.

Where the foreign flavors or gases in the milk are in excess of those ordinarily present the vacuum method of removing them, as above described, may be repeated or prolonged, and if desired, particularly where batch carbonation is resorted to, it will be found desirable in some cases to subject the milk to the vacuum treatment, then carbonate it and again subject it the vacuum treatment, removing the CO_2, and recharging the milk under pressure preparatory to packaging it.

Skim Milk, Buttermilk and Cream

Skim milk may be treated in substantially the same manner as above described with reference to the treatment of fresh milk, but in the case of buttermilk regard must be had for the acidity of the material, and the pressure adjusted in accordance therewith to keep it from coagulation or precipitation. Such pressure should be maintained preparatory to and during the vacuum treatment, after which the buttermilk may be cooled, carbonated and packaged, as described.

Also cream which has been cooled to or below 50° F., and contains acidity low enough to keep it from curdling, or the fat from churning, may be subjected to the vacuum treatment, and subsequently cooled to a point slightly below 50° F., after which it is charged with CO_2 and packaged in the same manner.

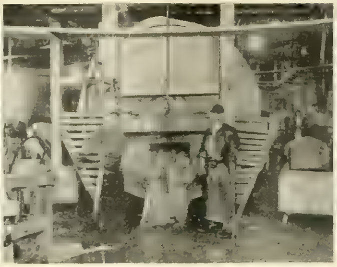
It frequently will be found desirable to reduce the acidity of the carbonic acid gas before charging the milk, and particularly before charging cream or buttermilk. The gas is preferably rendered slightly alkaline before using it for charging purposes so that it will not have any tendency to cause the milk to curdle. This will not always be necessary, but it will be very desirable wherever the conditions tend to promote a curdling of the milk, and such conditions are frequently present in cream and in buttermilk.

Milk packaged as described may be kept fresh, sweet, and wholesome throughout long periods of time at normal temperatures, although to secure the best results it will be desirable to store the packages under conditions which allow the maintenance of an even temperature, and preferably ranging from 35° F. to 50° F. A container or package containing such milk under pressure may be connected with a faucet, and the milk withdrawn for immediate use as an effervescent, wholesome beverage, having the full dietic value of fresh milk. The carbonic acid gas remaining in the milk acts as a mild stimulant, and an aid to digestion, and in fact its presence adds to the nourishing value of the milk.

---

*U. S. Letters Patent No. 1,403,223, granted Jan. 10, 1922

Trimming hides by hand.



Washing hides in wheel.

Liming and beaming.

Increased Efficiency of Leather Manufacture Is Possible Through Research in Fundamentals

By Arthur W. Thomas
Assistant Professor of Food Chemistry, Columbia University

THE art of leather manufacture is a fruitful subject for scientific research. Nearly everywhere one turns in the tannery, operations are going on wherein the demand for scientific study is glaringly apparent to the scientifically trained man.[*]

In the average tannery the majority of the many operations through which the product goes before it has been transformed from raw hide to finished leather are operations which are essentially the same chemically as they were centuries ago. Frightful formulae, similar to "shot-gun prescriptions" of the old school physicians, have been in the past jealously guarded by father, and carefully handed down to son with the admonition never to divulge the secret.

The point of view frequently is that since good leather was made in 1000 B. C., why bother about scientific research? Why is chemical or engineering skill required in an industry which thrived for centuries without the aid of chemists or engineers? This attitude is an obstacle at the present time which must be removed before the utmost improvement in the efficiency of leather manufacture can be accomplished. I predict that we shall see this impediment to progress in the leather industry overcome by one of the most natural and logical courses of business; viz., competition by scientific and progressive tanners.

The waste arising from rule-of-thumb methods is in many cases not apparent to some operators. For example in a certain manufacture of heavily greased leather a tanner treats the hides in the final stages of tanning with concentrated tan liquors in order to get increase in weight. When he attempts later to apply the greases he finds that they will not penetrate. Experience has taught him, that if he scours the leather previous to greasing, the greases will subsequently penetrate the leather. It has not occured to him that the scouring operation removed soluble matter previously put into the leather. This soluble matter was the reason for the failure of the grease to penetrate and naturally should not have been introduced in the first place. So the operation proceeds from day to day, the solubles are put in and then washed out again.

The foul practice of bating and puering with dungs is still to be found in some tanneries although Wood's investigations during the past 30 years showed them to be unnecessary. It was found that a proteolytic enzyme in the dungs was the active agent. Hence artificial bates may be prepared containing trypsin which in the bating operation digests and removes the elastin fibers and does not affect the collagen, or hide substance.

Recently even the value of the presence of pancreatic enzyme in commercial bates has been questioned by Wilson and Kern.

An important advance in the science of leather formation is the theory of Procter and his students, notably Wilson (1915-18). This theory accounts for the swelling of hides of skins, the falling of same upon addition of neutral salt to the solutions and the combination of skin substance with vegetable tanning materials. This theory has a chemical thermodynamic basis. The person who understands it as well as the colloid chemistry

Fleshing hides

Vegetable tanning

Alum tanning.

---

[*] Address before the Research Conference at the 42d annual meeting of the American Society of Mechanical Engineers, New York, December 8, 1921.

Removing wrinkles.

Shaving rough parts of leather.

Shaving the hide.

of tanning agents can discard all old rule-of-thumb formulas and run his operations on an efficient basis. He knows just why things will go wrong. He is not obliged to throw in a little of this salt, or of that acid to see what will happen to the hide; he knows in advance.

To give other instances where research has shown where waste can be eliminated, I would mention Stiasny's studies (1906) of liming which showed that the old idea of the necessity of the presence of ammonia in the lime liquors was unfounded, and which pointed out certain fundamental chemical requirements of lime liquors, as for example regulation of alkalinity and proportions of sulfide.

Studies on the nature of the combination of chrome with callogen have shown how chrome tanning can be carried out on an efficient basis. Tons of chrome have been run into the sewers due to lack of knowledge of the proper reaction of the solution to form the insoluble imputrescible chrome-collagen compound, chrome leather. If a liquor is too alkaline the chrome fixes on the outside of the skin and cannot penetrate to the interior. If it is too acid the chrome will penetrate, but not tan. Hence if the bath is started at a certain acidity and then the acidity gradually diminished, quicker fixation of the chrome throughout the skin takes place and furthermore the bath can be exhausted so that no chrome is thrown away. This has been accomplished by study of the significance of hydrogen-ion concentration in chrome tanning, many contributions along these lines having been made recently by J. A. Wilson of Milwaukee and by the laboratories of Columbia University.

The varying degrees of astringency of vegetable tans long have been recognized and accepted as a matter of course. A certain expensive tanning agent is prized for its mild astringency. Another much cheaper extract is very astringent and under rule-of-thumb procedure cannot be used in place of the mildly astringent one. Research in the chemical laboratories of Columbia University has shown that the potential difference of the particles against the aqueous phase is high in the case of the very astringent extract and low in the mild one. Since methods of varying the electrical charge of the negative tanning collodial particles are known, it is clear that a means for converting the cheaper astringent tanning agents to the milder one have been indicated.

Researches by J. A. Wilson have shown that tannin is generated by evaporation of a spent vegetable liquor in the presence of air. Certain organic substances are evidently polymerized and oxidized to tannins by this process. This would indicate that in some cases it might not be the most profitable thing to do to run spent liquors into the sewer.

Examples where chemical research has shown how to improve the efficiency of leather manufacture can be discussed at great length. It would be natural for me to expand along chemical lines since the problems in tanning are predominately chemical.

It is well known that a great cost factor in vegetable tanning is the long time consumed in the operation. This time can be greatly shortened. The Procter-Wilson theory which is in part based on the Donnan theory of membrane equilibria shows how this can be done, not to the "practical" man who scoffs at it as beautiful theory but to the scientifically trained mind which can grasp its significance. I have seen a cowhide that was successfully vegetable-tanned in three days.

It may seem strange to relate that researches on the physical chemistry of the proteins by Dr. Jacques Loeb of the Rockefeller Institute for Medical Research have been of great importance in leather manufacture. In general, Loeb's work supplements the Procter-Wilson results and in a number of cases it corroborates it.

Instances where mechanical engineering has improved the efficiency of leather manufacture are numerous. The designing of extractors and vacuum evaporators has made possible the manufacture of concentrated vegetable extracts which permit quicker tanning with

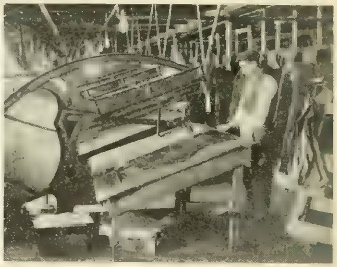
Buffing leather to remove hard part of grain.

Splitting [illegible] [illegible]ck view), showing [illegible] [illegible] split.

[illegible] [illegible] in the drum

Coloring machine; brushes spread color on the leather.

Hanging and seasoning.


Flattening leather.

more concentrated liquors and eliminates the expense of freight on barks, etc. Vacuum extractors have increased the yield and quickened the process. Machinery for unhairing, fleshing, shaving, etc., have eliminated much hand labor, but permit me to point out that a machine has not yet been invented which will completely unhair. Large mechanical rocking systems have improved the liming operation.

Since animals are primarily grown for their meat and wool the tanners are obliged to use a by-product as their raw material.

Disease in the animal is admittedly fatal to the meat industry, but it is also a factor from the tanners' point of view especially in regard to anthrax. The danger to the men handling hides infected with anthrax and the pollution of steams with this dangerous bacillus through tannery effluents have demanded research upon humanitarian grounds and through the compulsion of state laws. I am happy to say, that although this problem is not yet entirely settled, research has shown how it can be solved.

The warble fly problem has been acute. This insect lays its larvae in the hide of the animal and in addition to the misery caused the beast, the hide from such an animal is full of holes which show up distressingly after tanning. Research is now in progress to find a means of combatting the warble fly. The best method thus far found, as reported by Alfred Seymour-Jones, is to watch the cattle and to remove the pest from the cattle by hand!

Waste of time will be corrected, unnecessary losses will approach a minimum and curtailment of use of superfluous chemicals will be accomplished in the tanning industry through prosecution of scientific research in the *fundamentals* of the reactions taking place in tanning.

Use of Synthetic Resin in Chewing Gum

Harry M. Weber of East Orange, N. J., has extended the industrial application of synthetic cumerone resin by patenting* its use as an ingredient of chewing gum. Cumerone resin which is on the market under proprietary names is a mixture of para-cumerone, para-indene and polymers of other hydrogens found in coal-tar. It is obtained commercially from the sludges or residues in the refining of benzol, toluol, xylol, etc.

Cumerone resin may be prepared with various degrees of plasticity varying with the softer varieties, melting at or below 35-40° C., upward to the harder varieties, thus permitting the selection of a grade readily adapted to amalgamation with chicle to produce a mass apparently less sensitive to temperature changes than some of the chewing gum composition on the market.

In preparing chewing gum, whose customary ingredients are chicle, paraffin wax, etc., together with the usual sweetening and flavoring agents, it is desired to secure a product which will not soften too readily in warm weather or become unduly brittle in cold weather and which will assume readily the proper degree of plasticity when chewed. Chicle successfully meets these requirements but at a price ample to furnish incentive to provide a substitute at lower price.

One of numerous possible composition illustrative of Mr. Weber's use of cumerone resin is made by incorporating by aid of heat 4 parts of chicle with 1-2 parts of the synthetic resin and softened by the addition of 10 per cent. of colorless odorless petroleum oil of the type well known for its therapeutic use. The mass is then mixed with ½-¾ of its weight of sugar reduced to syrup of a concentration that will form a "hair" by the usual candy-maker's test, whereupon the flavoring ingredients are added and the mass rolled out, sheeted and cut.

Cumerone resin is recommended as an advantageous addition to the gum material commonly used, particularly chicle, to reduce its tendency to oxidize and become granular, thus impairing its chewing properties. It also is found that cumerone resin aids in the retention of flavor. Ethyl stearate has been found to have a marked softening effect on the synthetic resin; such slight proportions as 1-2 per cent. serve to reduce a resin of M. Pt. 75° C. to a consistency suitable for chewing gum manufacture.

The mass indicated by the following formula (parts by weight): Chicle, 100; cumerone resin, M. Pt. 62° C., 89; Russian petroleum oil, 10; and Ethyl stearate, 1, permits, on incorporation with syrup and flavors, a yield of about 600 parts, with improvement in chewing properties on ageing.

The gradual transition from the solid to liquid form makes difficult accurate determination of the melting point of many resins. The melting point referred to is that temperature at which the material in a powdered form or finely divided condition coalesces in a melting-point tube to form a fused, cohering mass.

The Phelps Dodge Corp., copper producers, has terminated its refining contract, in force for the past 17 years, with the Nichols Copper Co., and has entered into an agreement with the American Smelting & Refining Co. to have its copper refined at the latter's Perth Amboy, N. J., plant which has a monthly capacity of 10,000 short tons of refined copper.

---

*U. S. Letters Patent No. [illegible] issued [illegible], to Harry M. Weber, and by him assigned to the [illegible] Co., [illegible], N. J.

Industrial Research Must Justify Itself in Economies

Research Chemists Cannot Be Employed If Results Do Not Show a Profit

By F. A. Wardenburg

Assistant Chief Engineer, E. I. du Pont de Nemours & Co.

THE prime object of business is the making of money, and if research work is to maintain its proper place in business, it must be conducted so that it will more than pay its way.

Perhaps in no other work is it more difficult to foresee the difficulties liable to be encountered, and research work is always approached in a spirit of optimism. As a consequence, the cost is almost certain to be underestimated, not infrequently as much as 50 per cent., and the saving is very liable to be overestimated.*

As the work progresses the solution of the problem seems always just "around the corner," and more and more expenditure is incurred until the final cost may be greater than the saving effected. This is particularly true of the development of new machines or processes, but to almost as great an extent with an improvement to something existing. The result may be that the research, instead of decreasing waste, adds to it.

Insurance of Commercial Success

From the standpoint of the permanent success of research work, every possible means should be adopted at the inception of a problem and at all times during its progress to make the proposition a commercial success. As one of the methods of assisting in this, the following plan of a large corporation is outlined here:

I. When it is desired that a research problem be undertaken, it is required that there be filled out an "Experimental Request Form" giving:

(1) Title of research problem; (2) Process affected and plants to which applicable; Reasons for conducting research; (3) Description of process or machine in use which research work is to improve or replace; (4) Description of proposed improvement and how to be obtained; (5) Estimated cost of research work; Estimated savings or other advantages, given in detail to show clearly how saving has been figured and estimated capital expenditure necessary to put results into production; (6) Names of persons making suggestion or contributing major ideas; (7) Necessary approvals by executives authorizing the work.

It is surprising the many research problems which seem very promising when discussed in abstract, but which fail to pass the test insured by the filling out of the above form.

II. The man having charge of the research is required once a month to make a complete review of the problem, stating:

(1) Object of the investigation; (2) Work accomplished during past month; (3) Status of problem to date; (4) Probability of successful outcome and any new developments having a bearing on the application of the work commercially, if successful; (5) Further work proposed in immediate future.

III. Where it is apparent that the cost of conducting a research problem may be greater than the appropriation, an additional appropriation must be secured, at which time the commercial status of the entire subject is reconsidered by the executives to determine whether the expenditure of the additional money is justified. If not, the study is discontinued.

IV. At the conclusion of a research problem, a complete report is made, in which is included the estimated figure on capital expenditure necessary and the savings and other advantages to be gained by the application of the results obtained to regular production so that, if justified, the research work may be turned to profit as soon as possible.

This plan of conducting research work lays continual stress on the *commercial* outcome. At every angle the question is asked, "Is the cost of this particular step justified by the results to be obtained from it?"

Co-operative Research Proposed

Many companies in different lines are carrying on research work, each on problems in its own line. There are, however, many problems which should be studied but which are not receiving the attention they deserve because they do not present sufficient probability of making a satisfactory monetary return to justify any one company proceeding with the work.

Much research now done by manufacturing companies has to do only with that part of the subject which is of direct interest, frequently the effect of one or more of the variables is not determined, and frequently also, the study is only conducted to obtain a part of the curve. Further, there is a great deal of research work, of great importance to industry, but which is not done because it is seldom that any one company can justify conducting an abstract scientific research with the hope that the result of that research can be profitably applied to its business in some way.

True, a great deal of such work is being done by the universities or similar institutions, and some of it by the Bureau of Standards and other departments of the Government. The governmental departments, however, cannot be altogether depended upon because of the difficulty of securing the necessary appropriations.

This kind of research work in the universities must necessarily show slow progress because it must be carried on during the spare time of the member of the faculty who is working on it, and it is difficult for a man engaged in university work to have the perspective necessary to obtain the results in the way most suitable for commercial use. Further, the problem selected to be worked upon depends upon the desires of the man who happens to have the opportunity and desire for research work, and is not determined as it should be from a broad viewpoint to insure that the most important subject receives earliest attention.

How much better it would be if a fund could be collected by subscription from manufacturing companies and others interested, and this fund placed under the control of some central body which would fix a program of research work to be conducted, the place where the work should be done, and the methods to be followed in doing it.

With such a plan, information very necessary to industry would be obtained many years sooner than under the haphazard plan now followed. More complete and scientifically accurate information would be obtained, and the results would be much more widely distributed and made available for industry. As is quite important also, the total cost to industry would be very much less than where many concerns duplicate effort, as is now being done. To accomplish the best results, such a fund should be a continuing one, so that a program could be adopted for several years' work.

---

* Address before the Research Conference at the forty-second annual meeting of the American Society of Mechanical Engineers, New York, December 8, 1921.

The American Society of Heating and Ventilating Engineers has had such a plan in effect for the past two years, with subscriptions amounting to $25,000 per year for five years. The coöperation of the U. S. Bureau of Mines was secured, and the Bureau loaned excellent laboratory facilities in the fuel-testing station at Pittsburgh. This latter is equivalent to approximately $20,000 per year, so that the equivalent of $225,000 is available altogether in this instance. An excellent technical staff is employed and good progress has been made. The work is directed by the Research Bureau of the Heating and Ventilating Society.

Silicate of Soda in Flakes

THE production of flake caustic soda, permitting ready solution by consumers whose requirements do not warrant the purchase of "drum" caustic, and the production of flake sodium silicate whereby not only is the solid material offered in a form permitting ready solution, but a large saving made in transport costs, represent the translation into the manufacture of chemicals of what the industrial chemist recognizes as the chilled cylinder of the compound-lard plant and an early step in the evolution of the multiple effect evaporator.

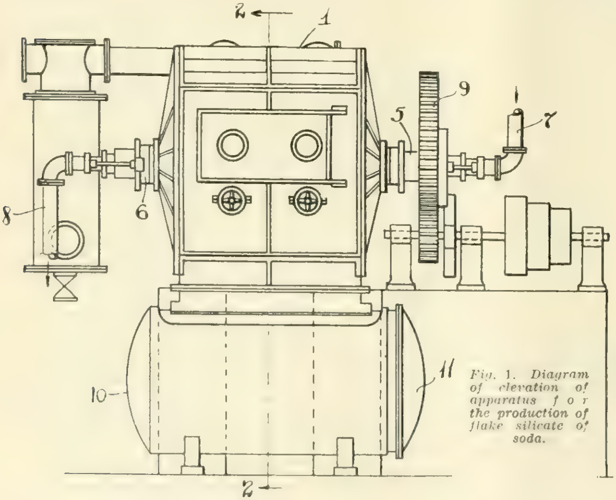


Fig. 1. Diagram of elevation of apparatus for the production of flake silicate of soda.

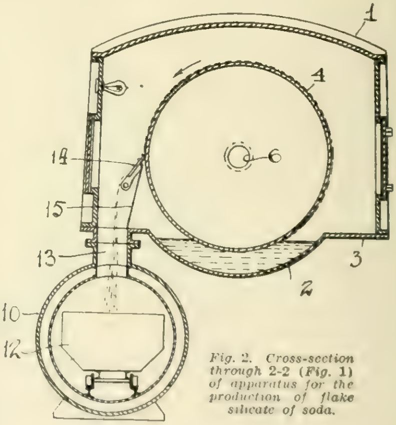


Fig. 2. Cross-section through 2-2 (Fig. 1) of apparatus for the production of flake silicate of soda.

I. D. Lihme, of the Grassilli Chemical Co., in U. S. Patent 1,403,556, granted Jan. 17, 1922, provides a method of concentrating sodium silicate solution, which avoids the breaking-down of the compound itself, and produces the dried silicate in flaky form, that is, in the form of a light powder, which is much more convenient to handle than the cake, and which, for obvious reasons, will enter readily into solution when it is desired to redissolve the same incidentally to its further use.

The production of sodium silicate in dry form heretofore has involved considerable difficulty, not only in the actual operation of drying, but also in the character of the product resulting from the evaporation of the solution. If such evaporation be attempted in an open receptacle, a film forms which tends to prevent the driving off of the water of the solution and at the boiling point of the water (212° F.) the silicate tends to disintegrate, with the precipitation of silica. The silicate, when produced in this way, moreover, is in the form of hard cake, which is difficult to redissolve and otherwise inconvenient to handle and use.

In Fig. 1 is shown in side elevation equipment used in the production of flake silicate of soda as patented by Mr. Lihme; Fig. 2 shows a transverse vertical section through the apparatus at 2-2 in Fig. 1. Within the vacuum chamber 1 rotates a steam-heated cylinder 4 whose periphery dips into a depression in the floor, 3, of the chamber, wherein is maintained at constant level, liquid silicate of soda. Steam is introduced into the drum through the axles 5 and 6 from the steam line 7. Rotation is effected by the belt-propelled gear 9. Exhaust steam is discharged at 8.

The chamber 10 with the detachable head 11 of Fig. 1 is shown in cross-section in Fig. 2, which discloses a car 12 into which through the opening 13 solid silicate is discharged as detached by the scraper 14. A deflector 15 prevents the solid from falling into the liquid silicate.

Operation

Upon admitting steam into drum 4 and properly reducing the pressure in the chamber 2, the liquid in the depressed portion 2 of the chamber's bottom will be caused to evaporate at a temperature considerably below boiling, such temperature preferably being around 180° F. As such liquid thus evaporates, a film of the dried material will adhere to the surface of the drum until it contacts with the scraper, which removes and discharges it into the chamber below.

Incidentally to the removal of the film in the fashion just referred to, it is broken up into a light, dry, flaky powder, which is readily soluble in hot or cold water by reason of its form and the fact that, at the temperature and under the conditions stated, the product is still in the hydrated form.

A New Device for Gas Absorption

H. E. Robertson, Ph.D.
Research Engineer

WHEN dealing with any problem connected with gas absorption or scrubbing, we must remember that to have a high absorption efficiency the gas and the liquid must have the longest and most intimate contact, for the reaction between the two phases, gas and liquid, takes place only at the surface of contact. The best effect is produced by having the gas pass upwards and the liquid descend under the influence of gravity. The intimate contact is accomplished by the exposure of a large amount of wetted surface to the action of the gas, and it is better if the surface consist of a thin moving film of the liquid.

By having the liquid in the form of very fine particles the surface is greatly increased, for if a given volume of liquid is reduced to particles of molecular size, the liquid will be almost entirely surface and thus any absorption which depends on the surface exposed, will be tremendously increased. There is the practical difficulty, however, that if the liquid globules are too small the absorption will be high, and a fog will be produced which cannot readily be controlled.

In practise the long time of contact and large area of wetted surface are combined if possible, and there are various methods in use. A tower has checker work or similar packing to break up the liquid and expose a large surface. The liquid particles may be reduced in size by spray nozzles or pumps which are used singly or combined with towers or scrubbers, but often there is the difficulty due to fogging. The scrubbers expose a large surface by various arrangements of rotating vanes and brushes.

None of these can be considered as 100 per cent. efficient and while satisfactory in many cases the cost of installation and operation, as well as the space required, make them out of the question for many operations

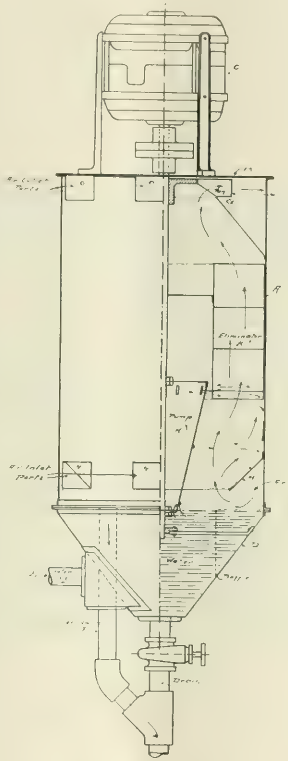


Fig. 1. Diagram showing construction and operation of a new air conditioner and purifier adapted to many industrial processes involving the handling of gases. Designed by S. C. Cutler, M. E.

Description of Gas Absorption Unit

A simple and efficient device for gas absorption and scrubbing as well as air conditioning and dust removal has recently been developed. In a compact, self-contained unit have been combined the principles which give the highest absorption efficiency.

In Fig. 1 is shown in diagrammatic section the construction and functions of such a unit.

A fine spray, but not a fog, is produced, thus giving a large surface, and the gas passes up and the liquid down, both necessary conditions in approaching 100 per cent. absorption.

The shell "A" is cylindrical in shape, with a motor "C" mounted on the top cover plate "B" and directly connected to the shaft which drives the paddle-wheel fan "G" and the pump "H" which has the shape of an inverted cone. The conical base "D" contains the liquid maintained at a constant level by the supply pipe "E" and the overflow pipe "F."

The pump is submerged slightly below the level of the liquid and due to capillary force a film of liquid starts up the outer surface of the cone and is then drawn up and thrown off at the projection by the action of centrifugal force. So we have a thin moving film and a fine spray. The bottom of the pump is perforated, allowing the liquid to rise along the inner surface of the cone and to be thrown out through rectangular slots located around the upper periphery of the cone. This produces a second spray and also wets the lower portion of the eliminator "N," encircling the machine just above the pump.

The gas is drawn in by the fan through six ports "L" located equidistantly around the circumference of the shell. The gas is deflected downward by the petticoat "H," first passing through the drip from this, on to the ruffled surface of the water and then up through the spray, and then passes through the eliminator. This consists of a series of baffle plates arranged vertically which completely removes any entrained liquid or solid particles by repeated changing of the velocity of the gases. After leaving the eliminator the gas is deflected to the fan inlet and discharged through the ports "O" located around the upper circumference of the shell.

Any solid matter collects in the conical base and can be removed by opening the gate valve "P." The liquid recirculates automatically until saturated and a series of machines set at slightly different levels may be used for a continuous process.

The apparatus occupies a minimum of space, for 1,000 cu. ft. of gas per minute can be handled by a machine two feet in diameter and four feet high. This high efficiency is due to the large wetted surface exposed by the spray and on the surface of the eliminators. Air can be completely saturated with water, i. e., reduced to the wet bulb temperature, without carrying over any entrained moisture and it is quite as efficient in absorbing various gases. Little attention is necessary, for there are no nozzles to become clogged and the flanged top and bottom permit of easy disassembly.

In Fig. 2 is a view showing the completed machine as set up with the arrangement of the bustle pipes for carrying the gas to and from the machines.

There are numerous applications for an apparatus of this nature in supplementing and replacing the more elaborate and expensive equipment, for it can be set up separately in units of the required size, whereby the efficiency of any reaction involving the scrubbing or absorption of a gas can be materially increased. There are many operations where gases or solvent vapors are being lost and could be recovered either for their value or for hygienic reasons by the use of the suitable absorbing material and equipment.

In the manufacture of illuminating gas there is a large field, for in coal gas the impurities to be removed are: tar, ammonia, naphthalene, cyanogen and hydrogen sulfide. The tar and ammonia are generally removed by a series of baffle plates, but this recovers only a part of the ammonia and the rest may be absorbed in water or sulfuric acid. The naphthalene is removed by passing the gas through a large rotary scrubber containing a heavy tar oil to absorb the naphthalene. The cyanogen is taken out by a similar scrubber using a ferrous sulphate solution. As these reactions depend on absorption and intimate contact the apparatus described here could be substituted with a large saving in space and power consumed. The absorption is independent of the rate of production of the gas, thus being flexible and efficient under fluctuating conditions.

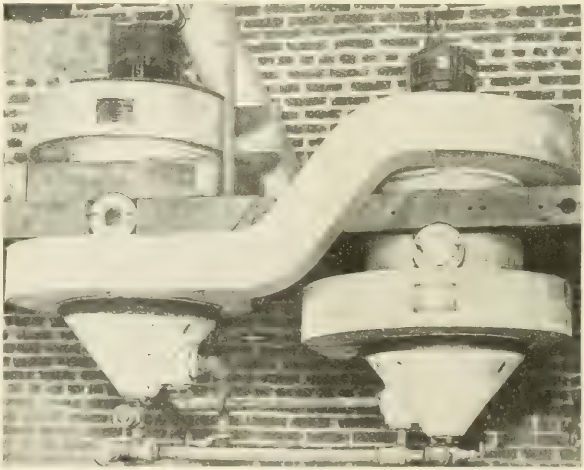


Fig. 2. Commercial installation of two units of the Cutler Air Conditioner, Purifier and Gas Absorber.

The present method of purifying the gas from hydrogen sulfide is by the use of ferric oxide, arranged in trays contained in large brick boxes. The labor and equipment necessary to change and revivify the oxide are a large item. The removal of the hydrogen sulfide by caustic or milk of lime, using the apparatus described, is equally effective and requires only a fraction of the cost in labor and size of installation. Water-gas purification is about the same and so the same argument holds here.

In the distillation of oil shale an important step is the recovery of the ammonia as ammonium sulfate by absorption in sulfuric acid. A similar problem is present in the production of gasoline from natural gas, which necessitates the scrubbing of the gas in some heavy oil. Both of these operations require an efficient, compact scrubber which will give the desired results with the least attention.

Sodium sulfite and bisulfite are made by passing sulfur dioxide through a solution of soda ash or caustic soda using a tower, or drawing the gas through a tank of the liquor. Any device, such as the one described, that would produce higher absorption and greater saturation would lower the cost of manufacture.

The sulfides of calcium and sodium are made by heating together the sulfates with coal or coke, but a pure product is not obtained directly. If hydrogen sulfide is passed through caustic soda or milk of lime a high concentration (30° Bé) of the sulfide is obtained which is sufficiently pure for use directly. This apparatus has been tested and found to give almost complete absorption under these conditions.

There are many other reactions, such as those involving carbon dioxide and ammonia where this machine would be readily applicable in increasing the yields.

In the present industrial reorganization it is highly important that all waste be reduced to a minimum. Any appreciable volume of gas that escapes represents a loss to the manufacturer and often a menace to the workmen in the plant or to the surrounding community. Small units of these machines, made of suitable material can be installed at the various points where the gases are escaping. Chlorine can be recovered as hypochlorite, sulfur dioxide as sulfite, hydrogen sulfide as a sulfide, and nitric acid fumes as nitrite or nitrate. Thus the nuisance could be satisfactorily eliminated and, if the volume is sufficient, a valuable by-product obtained.

Many drying operations, for example, such as those incident to the manufacture of fish scrap and leather, give off odors which must be removed, ordinarily by means of a water tower. This takes up considerable space and a great deal of water, both of which could be reduced by such an outfit as I have described.

The manufacture of artificial leather, lacquers and varnishes requires the use of large amounts of various solvents most of which are volatile as well as expensive. A great loss as well as an explosion risk arises from the escape of these low-boiling solvents; several elaborate condensing and refrigeration systems have been devised for solvent recovery in this field. An efficient scrubber containing a suitable high-boiling solvent for absorbing the vapors would have a wide application due to its ease of installation and economy of operation. The solvents could be recovered by distillation and the absorbent used again, which also is true of many distillations where an air-vapor mixture is difficult to condense but could be absorbed and recovered.

Many processes give rise to a dust which is always a nuisance and in many cases the dust forms an explosive mixture with air. The dust from vulcanite recently has caused several serious explosions. A spray system would remove the dust and recover it and do it without any risk of explosion, for the dust never comes into direct contact with the fan.

These are only a few examples of the possible applications of such a device in the chemical field and many more will be made evident on more extended use

The Lubricating Oil Business and the Work of the Lubrication Engineer

By William F. Parish

President, American Society of Lubrication Engineers

THE great general problems confronting American engineers today are the fuel situation and lubrication. All engineers are aware that the nation that can control and produce the greatest amount of cheap and suitable fuel for the internal combustion engine as well as for other power uses, will lead in industry. In so far as America is concerned, we now are importing crude and finished petroleum, our home production not being equal to consumption.

The fuels furnished the public for motor use have been gradually getting heavier year by year as the refiners have been compelled to cut deeper into the crude and develop cracking methods in order to meet the tremendous demands made upon them. The great output of our automotive industry and the apparently undiminished power of the people to absorb the production means still greater demands for fuel for the future. Insofar as fuels are concerned it can be said that "the cards are on the table" and that all parties to the problem have been freely discussing every angle.*

Lubrication

What is the matter with lubrication? Why do our best authorities give the problem of lubrication such an important place in engineering and on occasion some of them give voice to the thoughts of so many, that the subject is shrouded in mystery? Undoubtedly, the chief reason why there is such a lack of knowledge, and why whenever anything is said or written, there is such a diversified opinion on the subject of lubrication, is that practically little concrete data has been published.

The opinions of the various technical writers have been mainly based upon personal observations covering a very limited range of work, or are conclusions having a more or less theoretical basis, or are opinions stimulated to a greater or less degree by commercial motives but without any substantial basis of fact. There are sound basic rules that govern the art of lubrication just as there are methods, based upon facts, for the use of metals and other materials that have passed the elementary stages of discussion, doubt and diversified opinions. The subject of lubrication has been clouded by a quite natural chain of events. The history of the development of lubrication may tend to somewhat clarify the situation.

Historical

During the early ages and up to the era of the modern mechanics, lubrication, as such, was not a complicated affair. In fact the primitive construction of the various machines and devices that required lubrication were very well taken care of by the few materials available for lubrication. These consisted of animal and vegetable oils and fats.

The fact that the oils and fats were comparatively few in number and grouped themselves into three grades of lubricants, viz., the light, heavy and solid, indicates the simplicity of the methods of lubrication probably more than would a thesis on the machines and devices to be lubricated.

When the machinery became more complicated, which was within the memory of men now living, lubrication was still a simple art, carried on with only a few materials that had been developed and used for years. Chief among them being sperm oils for all light running machinery, castor, lard and rape seed oils for the heavier machinery and the tallows for the heaviest work and later for the heated bearings and for the cylinders of steam engines.

This condition in regard to materials used for lubrication existed in some parts of the manufacturing world as recently as thirty years ago. Sperm oil was used for the general lubrication of all the machinery of a spinning mill, from the spindles to the shafting bearings and the larger machines. Castor oil was the lubricant for the main engine and for the heaviest bearings in the rope shaft. Tallow was allowed to melt in a tea pot resting on the steam chest and the oil fed into the cylinders of the engine through the tallow cup.

The number of oils or lubricants was not great and the machines were not complicated nor were they driven at high speed under conditions where the lubricants employed to lubricate them would break down. When accidents did occur which could rightfully be charged to the use of a wrong material for lubrication they would be charged off as part of the cost and trouble that was involved in running the job.

Introduction of Mineral Oils

The great advances in mechanics associated with the last century would have been impossible without the mineral oils. As mechanical devices became more complicated and were worked under greater strains and temperatures the requirements made upon the lubricants were more exacting. Sperm oils were being used for the general lubrication of nearly all classes of light and medium machinery up to the early 70's. This oil was about 100 seconds viscosity at 100° F. on the Saybolt Universal viscosimeter, and had a cold test of about 40° F. This is the viscosity of a medium spindle oil of today, which is used only where the oil can be confined in a base and for the lightest and highest speed work.

Sperm oil was a remarkable material, in that the curve of viscosity was straighter than any of the other lubricants. That means that the body of the oil between the temperature at which it congealed and the highest temperature to which it could be subjected, was more uniform than any of the other oils, including those made from the mineral crudes. This oil was but slightly oxidized as compared with all other oils of animal or vegetable origin. Besides being a lubricant it was used in the lamps and torches for lighting the mill. It was used on the leather belts or bands to keep them pliable. It was also a good cutting oil when used in the shop. Its property of forming an emulsion when mixed with water also was made use of in certain manufacturing processes and in lubrication.

When sperm oil was at the height of its popularity and use the general improvement of machinery was taking place. It was the author's privilege to witness and officiate in many plants where the service rendered by this exceptional product was becoming impaired due entirely to the greater speeds and more severe conditions required by newer machinery that was being installed alongside of the older types. These newer machines would not work with the old-time oils. It was necessary to mix sperm and other oils with the new light-bodied mineral oils that were then being developed. As conditions of service became more severe the proportions of the mineral oils were increased until eventually lubrication was entirely taken care of by the petroleum oils. The change over to the mineral oils has been so complete that pure sperm oil has practically disappeared as an article of commerce and it can be obtained now only with difficulty.

---

* From a paper presented at the first annual meeting of the American Society of Lubrication Engineers, Chicago, October 12-13, 1921.

A Complicated Business Started

It was during this period of mechanical development that the complications in the lubricating oil business started. Sperm oil was taking care of work that would have required from five to ten mineral oils of different bodies, even with the old time machinery. Besides at least two kinds of burning oils, it also furnished several kinds of belt dressings, cutting oils and emulsifying combinations. This was also true, to an extent, of all of the animal and vegetable oils. With the gradual introduction of the minerals oils there was started the practice of blending and compounding with heavier or lighter-bodied mineral oils and with the animal or vegetable oils. This practice was, to an extent, necessary in changing over from the former fixed oils to the minerals oils. It led, however, to the development of the oil industry along the most complicated lines.

The practice was directly responsible for the present general mysterious reputation of the lubricating oil business. In a decade the lubricating practice of the world was one jumbled mass of disassociated facts due to the practice of producing a comparatively few number of oils at the refinery and of compounding, mixing and branding an immense and complicated number of brands of oils, many of them finally being used for the lubrication of the same class of machinery, as for instance, high speed machinery working under about the same mechanical conditions but being lubricated with a great number of different kinds of compounds and mixtures sold under a multitude of names all descriptive of the machine upon which the oil was intended to be used.

This brought about a condition where a mill would buy and use a "dynamo" oil, a "motor" oil, a "loom" oil, a "heavy spindle" oil, a "light-machinery" oil, called by these names and every oil would be different in character and also would be different in price. The mechanical conditions easily could be taken care of by two oils of the same body but of different finish and cost. Then developed a condition that was just as confusing wherein a mill would be lubricated with many different oils, from several oil companies, each oil different in name, price and reputation, but, as analysis showed, instead of ten there would be only two or three, the others being practically duplicates.

Commercial Conditions

It was unorganized trading. Every company and nearly every man in a fast growing industry operated as fancy pleased. There was no possible way of securing uniformity of application method. There was also a lack of adequate standards of measurements or of methods of description of the oils for classification purposes. Generally the conditions were brought about by following the lines of least resistance and allowing the business to just grow up. Brands and oils were added to every manufacturer's marketing list until finally the situation became impossible from an economic standpoint, requiring much duplication of effort, money and space in carrying similar oils under different brand names.

During the last seven years the marketing lists of all the main oil companies have been undergoing revision downward at a rate that shows that in the near future much of the confusion in regard to the subject will have been eliminated and the lists will reach a practical standard that will allow of the proper training of the men handling the business, and result in a better understanding of the subject on the part of the technical public. To show what has been accomplished it may be cited that one large marketing company reduced the brand names in its price list from over 800 to about 200; another from several thousand to several hundred.

Even with what has been accomplished in the general interest of economy by the main oil companies there is still room for greater simplification. The industrial engineer charged with the responsibilty of selecting lubricants for a plant or machine has a confusing lot of oils and brands and ideas thrust upon him. Generally the more oil men he interviews the more confusing the situation becomes. If the engineer has a laboratory at his disposal and has the oils analyzed for a few of their physical characteristics he will find, as a rule, that for a given machine each company will surely recommend an oil entirely different from those recommended by the others. Such has been the general practice in the past. A careful description of a machine required to be lubricated was sent to several oil companies. This resulted in one case of 35 oils being offered, no two alike. The oils ranged from the lightest of the engine oils to the heaviest of the cylinder oils. This sort of work has been noticed by many practical men and adds to the general mysterious reputation of the lubricating oil business.

Is it any wonder, then, that lubrication, to the outside engineer looking for enlightenment, consists of a series of inconsistent rules and opinions that seem to make mastery of the subject almost impossible? The average engineer feels that he can make much more use of his time in other branches of engineering than in helping to unravel the lubrication situation.

Conditions are improving. The greatest number of brands were carried by all oil companies in the past when mechanical conditions were not as severe as they are today. The fact that the greater and more difficult service can be handled by a comparatively few number of oils is most encouraging.

Work of the Lubrication Engineer

This simplification of practice has been mainly brought about by the lubrication engineer. He has been the practical man on the application side of the oil industry and it has been his particular business to study the mechanical condition of all other industries and solve their lubrication troubles. The engineers of the pump and tank industries, the filter engineers and engineers who have designed and installed lubricating systems have been great factors in simplifying the art of lubrication. And of late years lubrication engineers have been attached to the engineering departments of many great industrial plants. These engineers have been doing a good and necessary work.

The lubrication engineer primarily is interested in all the economies that can be effected through the use of lubricants. He must have a wide knowledge of mechanics and also of oils. It is his duty to see that the right kind of oil is used for the work to be done. When the lubrication engineer is operating for the purchaser or is employed by the plant to look after lubricants he must organize the entire matter of handling the petroleum products so there will be no waste in storage or in use. He also must arrange matters so that all lubricants that have been used and not destroyed can be reclaimed so they can be used again.

Grades of Oils

When a machine is developed to a production basis, it generally has passed all the childhood troubles with lubrication and will emerge a consumer of a light, medium or heavy oil. In a very few instances some slight mechanical complication will require the machine to be classed as a consumer of the extra light or extra heavy oils, or even of a specialty. The great mass of machines easily fall within the ranges first mentioned.

The grade or character of oil can be different for each classification. Oils can be produced cheaply and the same oils can be worked over and finished into better lubricants without materially changing their physical characteristics, but materially increasing their cost to the producer and the consumer. Whether the increased cost is justified is a matter for the lubrication engineer to judge after he has carefully watched the performance of the oils on the machine.

As a rule the best oils produce the best results in the long run. Take, for instance, the circulating system of a rolling mill engine. The cheapest kind of a medium oil may be in use and it might be thought that this would be the best practice. This oil allows the bearings to run for considerable periods without excessive heat and the lubrication may be generally satisfactory. The oil, due to the fact that it has been rather neglected by the refiner and not put through all the necessary processes due to the cost, will prove a bad actor when it comes to working with water. It will form sludge and emulsions, or it might stain the bright parts and require extra labor to keep things clean. Some cheap oils will get very heavy and require renewal more often in the system. Some of the worst will have to be thrown away entirely after periods that make the cost per month excessive when compared with the better finished oils that will stand more severe service.

In work of the most difficult nature, such as the lubrication of internal combustion engines, air compressors and turbines, only the best finished oils should be used, and this means that everything entering into the oil must be of the best. It generally happens that an oil made up of two stocks, one good and one poor, will retain all the nature of the bad and none of the good. These matters are within the province of the lubrication engineer to guide and correct. If he is connected with an oil producing company it is his duty to give the matter his best attention as he is after the business and must give service. If the lubrication engineer belongs to the consuming business it is his duty to use the best oil for every class of work.

There is no logic in the belief that ignorance of the consumer aids the seller. Someone, nowadays, is always willing to educate the consumer in some manner, and the history of the development of the newest and most powerful companies shows that they secured their hold through educational methods coupled with good and different products intelligently applied.

Our industrial history during the last ten years cites many instances where manufacturers have at first failed to see the advantage of uniform and popularized commodities. These same manufacturers, after trying the more modern way of handling their business, would never revert to the former policy.

Advice to the Young Chemist

We commend to the young chemist, whether undergraduate, or on the lookout for an opening, or in his initial steps in industry, the discussion by "T" in the *Cotton Oil Press* of the problems that confront the young man entering upon a career in industrial chemistry. He classifies the field, as did Caesar of all Gaul, into three parts, to wit:—(1) plant work requiring chemical engineering training; (2) selling the goods, wherein technical training is of decided advantage when coupled with innate qualifications of salesmanship, and (3) laboratory work doing "constructive" research.

He says that, from the viewpoint of American industry, it would seem that a great many more chemists are needed in the first two phases, that is, in plant operation and selling than are needed in the laboratory for research, and this is fortunate, for there are comparatively few men who by temperament, patience, and training are fitted to do, successfully, research work.

The question facing a young man fresh from his technical training is to determine in which phase of the industry he will make the greatest success and how to get started towards that particular field. Take, for instance, the young chemical graduate who has made up his mind that he will go into the plant operation or into the sales end. He may start in one or two different ways, either by attempting to get into the laboratory and work up through the laboratory into the department towards which he is aiming, or he may take his education as an asset and get a position in the industry along the lines which he desires to go and using his technical training to get him ahead.

A great many men go through the laboratory as a stepping-stone to the other departments, but I believe that a man will probably get farther in the end by going directly towards the object which he has in mind, as many men going into laboratory work become more or less side-tracked from the line of work for which perhaps they would be better equipped.

Undoubtedly there is an opportunity in the chemical laboratory for a man to make this his specialty, but to be a success in this requires peculiar characteristics and training. I think a young man considering his future should be very certain that he is temperamentally and educationally equipped for research work in the industry before he starts into the work, with the idea of making that his particular field.

The principal trouble with most college trained men in chemistry at the present time is that they are trained to believe that research is the only field for them, when as a matter of fact the industry needs them in every field, and few will be successful in research. It seems to me that the biggest field for chemists is to fill the need of trained men in the industries themselves and not primarily as chemists.

A local branch, under the leadership of Charles B. Hall, sales manager, chemical department, Cleveland-Cliffs Iron Co., of the National Association of Chemical Salesmen has been formed at Cleveland, Ohio.

Limitations of Trade Association Activity

By Gilbert H. Montague

Member of the New York Bar

SECRETARY OF COMMERCE HOOVER and Attorney General Daugherty have done much in their correspondence made public on February 16 to clear up the confusion regarding lawful and unlawful trade association activities that has existed in many quarters since the Supreme Court's decision last December in the Hardwood Manufacturers' case.

On the Attorney General's side this correspondence necessarily is guarded, because many cases involving trade associations are now awaiting trial, and the Linseed Council case, in which the Government is appealing from Judge Carpenter's decision last November in Chicago, will soon be argued in the Supreme Court.

Guidance to Business

That the Attorney General, notwithstanding these pending cases, should have co-operated with Secretary Hoover in this correspondence is convincing proof of the Administration's realization that business men urgently need and honestly deserve advice and guidance regarding trade association activities.

This correspondence endorses many activities, such as standardization of quality, grades and technical designations, elimination of wasteful processes, prevention of dishonest practices, handling of group insurance, co-operative advertising, promotion of welfare work, co-operative representation on legislative questions and transportation matters and co-operation with Government departments and bureaus that have never been legally questioned.

What is said about uniform cost accounting and uniform trade labels will be interesting to many as showing that the Attorney General disapproves of uniform trade labels and is somewhat suspicious of uniform cost accounting because of the ease with which both may be used to curtail production, enhance prices and suppress competition. Most interesting of all, however, are the Government's views on the interchange of trade information through trade associations.

What Associations May Do

Briefly, the Attorney General advises the Secretary of Commerce that if there be no purpose or effect, whether intentional or unintentional, of curtailing production, enhancing prices or suppressing competition trade associations may

I. Collect statistics from each member showing his volume of production, his capacity to produce, the wages paid, the consumption of his product in domestic or foreign trade and his distribution thereof, specifying the volume of distribution by districts, together with his stock, wholesale or retail.

II. On receipt of the individual reports of each member compile the information in each report into a consolidated statement which shows the total volume of production of the members, by its capacity to produce by districts of production, which in some instances include a State or less area, the wages by districts of production, the consumption in foreign or domestic trade by districts, the volume of distribution by districts and the stocks on hand, wholesale and retail, by districts.

III. File the combined statement with the Secretary of Commerce for distribution by him to the members of the association through the public press or otherwise, and to the public generally and to all persons who may be in any way interested in the product of the industry, it being understood that the individual reports for the members should cover either weekly, monthly, quarterly or longer periods as may be deemed desirable by the members, and when a period is adopted the report for each member shall cover that period and the combined report shall be for that period.

IV. Have their members report the prices they have received for the product they have sold during the period taken, specifying the volume of each trade, brand, size or quality, as the case may be, and the price received for the volume so sold in each of the respective districts where the product is sold.

V. Consolidate all the reports into one and show the average price received for the total volume of each grade, brand, size, style or quality, as the case may be, distributed in each district, covered by the distribution statistics for the period covered by each individual report, and

VI. Send the compiled report as to average price, as aforesaid, to the Secretary of Commerce, to be by him distributed to the public and to any or all persons who may be interested in the particular industry making the report.

Freight Rates and By-Product Coke Industry

The present complex of transportation rates originally involved some definite relationship to the value of commodities wherein charging what the traffic will bear had an economic basis. This conception of ratemaking, however, has been destroyed by the horizontal raises which have fallen with great inequality on different commodities and have affected unfairly great groups of people.

Secretary of Commerce Hoover in a statement Feb. 3, before the Interstate Commerce Commission sets forth these facts and explains that, as the country grew up, its industries were distributed under ratios of costs between different commodities, ratios between raw materials and finished goods, ratios between the farm and city. These have all been distorted by the horizontal rises. The increases in rates since 1914, for instance, have added probably less than 1 per cent to the price of cotton goods on the average haul, but it has added probably 60 per cent to the price of coal. The increased rates since 1914 have added nearly 100 per cent to the cost of assembling the materials for pig iron.

All this artificially forces our industries to move toward their raw materials. This does not alone represent the starting of a new factory; it is a movement of the whole mechanism of the community, labor, homes, schools, railways, and what not—an enormous duplication of plant and loss of capital. We will ultimately have the rates readjusted, and then we will destroy the new industries created under it.

As regards the by-product coke industry, which supplies the basic raw materials of our organic chemical industries, the present high rates on coal and coke have had the effect of preventing by-product coke plants from operating and have restricted development of the by-product coking industry.

Some by-product plants have been shut down owing to high freight rates, and stocks of by-product coke in the country aggregating 1,017,000 tons have accumulated, located as follows: Jersey City, N. J., 280,000 tons; St. Paul, 115,000 tons; Indianapolis, 131,000 tons; Terre Haute, Ind., 71,000 tons; Camden, N. J., 33,000 tons; Detroit, 57,000 tons; St. Louis, 55,000 tons; Kansas City, 50,000 tons; Milwaukee, 75,000 tons; Chicago, 85,000 tons; Geneva, N. Y., 25,000 tons.

By-product plants cannot compete with Connellsville beehive ovens because the former have a double haul—coal to ovens and coke to consumers—which results in pyramiding and increasing freight rates, especially since it requires 1.25 tons of coal to make one ton of by-product coke.

Solvent Extraction in the Production of Oils and Fats

By Ludwig A. Thiele, Ph.D.
Consulting Chemical Engineer

IN this period of general depression and deflation, it seems to be particularly appropriate to call the attention and serious consideration of those engaged in the production of oils and fats to a process of manufacture whereby more oil and at less cost can be obtained, i. e., the method of extraction by means of volatile solvents.

It is quite generally conceded that we are a wasteful nation and it behooves us therefore to pay close attention to the improvement of existing manufacturing processes and the elimination of waste if we want to keep on going ahead and continue to pay dividends.

In the past, especially with high prices in a seller's market, we were only too eager to push production for all it was worth and too prone to neglect to obtain a few percent of product, which we might have had just as well. This 8 or 10 per-cent of residual products now going to waste, sooner or later may spell a disastrous future to quite a few of those continuing to neglect the improvement of their manufacturing processes.

The vegetable oil industry, and likewise the rendering establishments and slaughterhouses all over the country, use in the majority of cases the expression process of obtaining oil or fat. Now, it is a proven fact that, even with the most powerful presses, the oil can be expressed only to such an extent that still from 8 to 10 per-cent remains in the residue or press-cake. Cracklings retain as much as from 12 to 25 per cent., and often more than that, of fat. Hair, tankage and glue-kettle residue hold 11 to 14 per cent. of grease. Such an enormous amount of fat should not be allowed to go to waste, but should be saved by all means possible.

As it is, the amount of oil or grease in the press-cake when sold as a stockfood is not paid for as such and constitutes therefore a money-loss. Such press-cake furthermore tends to turn rancid within a certain length of time. Moreover the feeding of rancid oil-cake is more deterimental than beneficial to the animal, as it produces "scours" in the animal which thereby is prevented from putting-on flesh, thus also imparing the milk supply.

So the loss is practically twofold, viz., from the manufacturers' as well as from the feeders' standpoint

By extracting all the oil, grease, or fat-yielding materials with volatile solvents, we obtain practically all the oil, consequently only a fraction of a percent is left in the extracted oil-meal.

The albuminoid ratio of extracted oil-meal is narrower than that of the press-cake. As a stockfood is the better the narrowed the albuminoid ratio, it follows that extracted oil-meal has a larger feeding value than rancid press-cake.

Of course there is still some "prejudice" in some quarters to extracted oil as well as to extracted oil-meal. Some contend that extracted oil retains solvent or too much solvents and so interferes with the refining processes. It may safely be stated and without fear of contradiction, that extracted oils, after refining, are absolutely equal to the best expressed oils and suitable for all purposes to which an expressed oil may be put.

Others shy at solvent extraction on account of the risk involved by fire or explosion. It is true that in the past fires in extraction plants have occurred, and it is also true that sporadically a plant has been known to be "blown-up"; but there always has been a very plausible reason and explanation why such accidents have occurred. And again the writer has operated and known gasoline extraction plants which never have had the slightest mishap in years on end.

On the other hand, like many other processes, that of extracting oils by volatile solvents has seen a great many improvements since its inception by William Adamson of Philadelphia and Friedrich Seltsam of Forschheim in 1879 and 1880 respectively.

The apparatus as used by these original inventors has undergone great variation in construction, so that at the present time there are more than 50 different types of extraction plants which are in more or less successful operation.

The same refers to the solvents used. In the beginning carbondisulphide was used exclusively; but as this solvent imparted a very bad odor to the oil as well as to the residue, its use was discontinued and canadol gasoline substituted for it.

Today we have an array of over 20 different solvents from which to choose. These solvents can be placed in two groups: Solvents lighter than water, as acetone, alcohol, ether, gasoline, benzol, toluol, xylol; and solvents heavier than water, as carbondisulphide, naphthalene, chloroform, carbontetra chloride, tetra-, penta-, per- and hexa-chlorethane, di and tetra-chlorethylene, trichlorethane and trichlorethylene.

It will be noted that all the solvents of the first group, which are all lighter than water, are flammable and explosive; while in the second, heavier-than-water group only carbondisulphide and naphthlene are flammable. A solvent which is non-flammable and heavier than water should be preferable for the reason that it can be kept and condensed under water, thus effectually preventing evaporation, which factor must be taken in consideration when dealing with the first group. On the face of it, therefore, it would seem that all the members of the second group with the exception of carbondisulphide and possibly naphthalene would be the most suitable solvents. But in the second group all is not so well either, inasmuch as some members like carbontetrachloride and others have a tendency to attack the walls of iron vessels in the presence of moisture or at elevated temperatures. As practically all oil-bearing material contains moisture and as the last traces of solvent are driven off by live steam, it follows that iron vessels are unsuitable for use with these solvents.

Lead-lined or glass-enameled apparatus would have to be provided if solvents of the carbontetrachloride type should be used. Such apparatus of course increases the first cost of the plant.

In trichlorethylene and others we have the addel advantage that these solvents, besides being heavier than water and non-flammable, do not attack the walls of iron vessels either in the presence of moisture or at elevated temperatures. Trichlorethylene offers therefore the most important advantages and may be used to equally good advantage in the extraction of nuts, castorbeans, oilseeds, press-cake, bones, fish, fishscraps, tankage, hair, glue-kettle residue, wool, cotton-waste, leather offal, skins, stearin, paraffin, beeswax, bitumen; the residue from refining and bleaching operations and for the extraction of resins, varnish gums, sulphur, etc.

As practical commercial solvents we have to consider (1) gasoline, benzol, toluol, and xylol, which are flammable and (2) trichlorethylene, trichlorethane, which are non-flammable all of which may be used in iron extraction apparatus.

Contrasting gasoline with trichlorethylene, the latter offers the greater advantage by reason of: Larger yield of oil; smaller oil-content in residue; smaller total solvent loss, as condensation takes place under water, effectually preventing evaporation; more rapid extraction (saving in time); greater purity of oil; and non-flammability, therefore no fire hazard.

The advantage of gasoline against trichlorethylene resides mainly in the matter of cost. Gasoline is cheaper but the final cost is not very much different for both solvents, as the losses by gasoline are quite naturally larger.

Existing gasoline-extraction plants can be arranged for use with trichlorethylene, requiring only a slight change in construction thereby eliminating entirely the fire-hazard and danger from explosion.

The best extraction plant therefore, is that, which produces the best quality and largest quantity of oil in the shortest possible time at the lowest first cost of operation, and embodying safety in operation.

In my practice I have found that the solvent loss of a well constructed and properly operated extraction plant, using gasoline, amounts to 0.7 percent based upon the weight of the raw material, and still less by the use of trichlorethylene.

The cost of extraction per ton of material, including solvent loss, labor, steam, water, depreciation (10 percent), interest and taxes (10 percent), may be stated to be not in excess of $3.00 plus or minus 5 percent, and based upon yearly averages.

As a safe and fireproof installation offering such large returns at so low cost of operation, solvent extraction is destined to become the greatest factor in increased production of oils and fats and in the elimination of waste in this industry.

Canadian Institute of Chemistry

The official publication of the Canadian Institute of Chemistry, *Canadian Chemistry and Metallurgy,* referring to the designations, F. C. I. C. and A. C. I. C., indicating respectively Fellow and Associate members of the Canadian Institute of Chemistry, says that these designations mean that the profession of chemistry is the lifework of the holder and that the owner is, nine times out of ten, at least a Canadian. If you have the attainments and are proud of your profession and the possibilities of your country it is reasonable to suppose that you will join with others who aim to make the Canadian Institute of Chemistry the recognized body of professional chemists in Canada.

The Institute has now the sole right to use these designations by Dominion Charter, and the qualifications they set up for membership are high enough to make this status a distinct honor.

Machinery is created so that three grades of members are recognized, namely, Students, Associates and Fellows. From the initial decision to enter chemistry anyone may become a member as a student. As attainments are secured, the rank of Associate may be reached, and, as a final mark of independent success in some particular line, the rank of Fellow is reserved.

The options for qualified Canadian chemists are three. They may join the Institute, using the Dominion-wide organization, which it has created, and play their part in it, becoming regular enthusiasts about matters which are vital to their success in a broad way. They may create some type of machine better than the Institute for this purpose, or they may hold back and plow a lonely furrow, nursing a perpetual mental canker, which may eventually dwarf their careers, leaving them unfitted to represent properly such a growing profession.

For those who have a natural disposition to stand aside and alone, and are not particularly well developed in their professional social instincts, the work of the Institute would make an extremely good tonic. A great number of the leading chemists of Canada are now members and others are joining rapidly. Wide awake students in our universities who value the association with leaders in their profession are forming and joining student branches. We foresee a time when practically all chemists with the qualifications will be members, and when the industrial world will judge the rank of the chemists they employ as much according to this measure as by any other.

The letters F. C. I. C. and A. C. I. C. stand for something in Canadian chemistry. If you have the right to do so use them.

Co-operative Buying of Technical Counsel

The Associated Industries of Massachusetts, an organization of manufacturing corporations in the state of Massachusetts, with headquarters at 1034 Kimball Bldg., Boston, has appointed Harvey J. Skinner of Skinner, Sherman & Esselen, Inc., chemists, biologists and engineers, to conduct its Technical Information Service Department along lines similar to those of its legal, taxation, accounting, insurance and banking services.

This new department is equipped to answer inquiries on the fundamental processes employed in manufacturing operations, such as steam generation, water softening, lubrication, heating, drying of materials, filtration, distillation, evaporation, dyeing, etc., and to supply members with knowledge which will be of material aid in solving problems of construction, the properties of building materials, the selection of the more important types of equipment for certain operations, the erection of machinery and the like. It is also in a position to direct members to sources of information on technical subjects and to places where materials or equipment can be obtained to the best advantage.

The announcement states that it may be difficult in certain cases to draw an exact line between the data which should be furnished free to members as part of the service and that for which a member should retain a competent firm of chemists or engineers. It is the belief of the executive committee that this difficulty will be no greater in the case of the technical information service than it is in connection with its legal, taxation, accounting, insurance and banking services, where the line has always been drawn to mutual satisfaction with reference to each particular case as it arose.

A certain group of manufacturers have been asking for more than mere protection. I am a Democrat, but not a free trade Democrat. I believe in ample protection, sufficient to cover the cost of production between here and other countries. In other words, I want a competitive tariff, and even a little better, because I want goods produced in this country and not by labor in other countries, but I do not want any kind of an embargo which tells a consumer on this side that he cannot get anything he wants if he is willing to pay for it. I do not want departmental clerks in Washington under the licensing system to tell me that I cannot have this or that but have to use something else just as good, and that is my reason for objecting to the embargo and licensing system. *Herman A. Metz*

Muscle Shoals and Henry Ford. III.

Paternalism Has No Place in Chemical Industry

As the hearings have progressed before the House Committee on Military Affairs in Washington, the true inwardness of Henry Ford's proposal for the acquisition by him of the water power and nitrate properties at Muscle Shoals has become more and more apparent.

The Fertilizer Fetich is a Smoke Screen

Members of the committee have learned from Mr. Ford's own representative, Mr. Ford himself was too busy to appear in person and offered his Chief Engineer, W. B. Mayo, as substitute, that the Detroit manufacturer has no intention whatever of making fertilizer or fertilizer materials at Muscle Shoals unless he can do so at a profit. Other witnesses, including General C. C. Williams, Army Ordnance Chief, and Dr. Richard C. Tolman, in charge of the Fixed Nitrogen Research Laboratory of the Department of Agriculture, have established the fact that sulphate of ammonia could not be produced at Muscle Shoals at a cost less than from 33 1-3 per cent. to 50 per cent. above the present wholesale market price. As sulphate of ammonia is the only form of fixed nitrogen, capable of being made by the cyanamid process, that has so large a sale in the fertilizer industry as to supply a market for a substantial percentage of the possible output of the great Muscle Shoals plant, some members of the committee have been driven to the conclusion that the fertilizer end of Mr. Ford's proposal does not amount to much.

Mr. Mayo, accordingly, was asked the direct question whether, after all, the thing Mr. Ford is interested in is not primarily the water power. As a water power proposition the Ford proposal has nothing like the political strength of his indefinite promise to the farmers to reduce the price of fertilizers; and Mr. Mayo was very hesitant to admit that the fertilizer end of the proposal did not bulk very large in the consideration of his chief.

Alabama Power Co.'s Proposal

Now comes the Alabam Power Company with a definite proposal to develop a water power at Muscle Shoals, leaving the Government in possession of its nitrate plants, and delivering to the Government free of charge a large block of power for any use it desires in the manufacture of fertilizers or munitions of war. This proposal of the Alabama Power Company is the most important development in the Muscle Shoals situation since the matter was last discussed by Chemical Age. Because of its great interest to the chemical industries, and the importance of accurate information on the subject, we give this proposal in full. It is as follows:

February 14, 1922.

Hon. John W. Weeks, Secretary of War,
Washington, D. C.

Sir:

This company offers to carry out the following plan by which the Wilson Dam at Muscle Shoals may be completed and the nitrate problem of the Government in connection therewith may be simplified without further advances or expenditures by the United States:

1. To take out a license under the Federal Water Power Act under which we will complete the construction of the dam, locks and power house at Muscle Shoals, known as Wilson Dam, or Dam No. 2, at our own expense, with initial installation of approximately 240,000 h. p., subsequent installation to be made in accordance with the Federal Water Power Act as may be necessary to meet the market demands.

2. To furnish free to the Government, or anyone it may designate, from the hydro power plant, 100,000 h. p. as required for the production of fertilizers and munitions of war and for research in connection therewith; and if, due to changes in the art, this use of such 100,000 h. p. is discontinued by the Government, the Alabama Power Company to purchase and pay for same in accordance with a schedule to be set forth in the license. This power to be the second 100,000 h. p. at any time available from the normal flow of the river.

3. To purchase the Government's interest in the Warrior extension of the steam plant of Alabama Power Company, and facilities, the Warrior and Sheffield substations, the transmission line from Warrior to Sheffield, and the steam plant at Nitrate Plant No. 2, together with the necessary rights of way, lands and housing facilities, and to pay therefor in five equal installments the sum of $5,000,000, less an amount to be agreed on to cover the costs of locks and navigation structures at Wilson Dam; the first payment to be made when license is granted, the remaining payments to be made in four equal annual installments with interest at five per cent. with the right to anticipate any part or all of same.

4. To operate and maintain the power plant, dam and gates, the Government to operate and maintain the locks for which the Power Company will supply the necessary power without expense to the Government.

5. The Government to transfer to the licensee the Wilson Dam property represented by its investment and commitments to date, free of liabilities and unincumbered, including the construction plant. The locks and navigation structures to be conveyed to the Government in fee on completion of construction.

6. Whenever the safety of the United States demands, the United States shall have the right, as more fully provided in the Federal Water Power Act, to take over and operate the project covered by the license for the purpose of manufacturing nitrates, explosives or munitions of war, or for any other purpose involving the safety of the United States for such length of time as may appear to the President necessary for such purposes.

7. The project covered by the license to be subject to recapture by the Government at the end of fifty years under the terms of the Federal Water Power Act.

8. The licensee will agree to begin the construction promptly upon the enactment of the necessary legislation and granting of license and to complete the same within a reasonable time thereafter.

To facilitate the carrying out of this plan, we may find it necessary to organize a new company for the purpose, in which case, however, the obligations of this offer shall be binding upon this company in all respects as if it were the licensee.

ALABAMA POWER COMPANY.
By Thomas W. Martin, President.

Comparison of Proposals

Congress will have an opportunity to compare these two proposals and consider which is more desirable from the point of view of the Government. In this consideration the following differences will be emphasized:

I. Mr. Ford asks for a lease to the water power for a period of 100 years, with certain renewal privileges that some members of the House Committee believe would amount virtually to a perpetual control. The Alabama Power Company, on the other hand, offers to take a license for 50 years under the provisions of the Federal Water Power Act.

II. Mr. Ford proposes to have the Government complete the water power with its own funds (now estimated by the Army engineers at $40-$50,000,000, exclusive of the cost of certain flowage rights for the smaller of the two dams); whereas the Alabama Power Company requires no expenditure whatever of Government funds and agrees to finance the entire proposition with private money.

III. The Ford proposal requires not only the completion of the Wilson Dam (Dam No. 2) and its power house, but also the construction of Dam No. 3 with its power house; whereas the Alabama Power Company proposes only to complete Dam No. 2.

IV. Mr. Ford requires the Government to install power-house equipment for 850,000 horsepower, whereas the Alabama Power Company proposes to make an initial installation—with their own funds, of course—of 240,000 horsepower, and additional installations as the market for the power is developed.

V. Mr. Ford proposes to buy certain nitrate and power plant properties from the Government for $5,000,000. These include Nitrate Plants Nos. 1 and 2, with the Waco limestone quarry developed to furnish a raw material for Plant No. 2. They also include the 60,000 K. W. steam power plant at Muscle Shoals, the 30,000 K. W. extension built by the Government to the Alabama Power Company's steam power plant at the Warrior River, the small power plant at Nitrate Plant No. 1, and the transmission lines connecting these various power plants (the line from Warrior River to Muscle Shoals being 88 miles in length). The Alabama Power Company proposes to acquire from the Government simply the two large steam power plants, one on the Warrior River and one at Muscle Shoals, with the transmission line connecting them. They will pay the Government $5,000,000 less the cost of navigation structures in connection with the Wilson Dam. This deduction from the $5,000,000 payment to be made by the Alabama Power Company for this property may prove quite substantial. In comparing the two offers it will be had in mind, however, that in the first place the Alabama Power Company does not demand the delivery to it of the deeds to the Nitrate Plants, as Mr. Ford demands under his proposal; and, secondly, that in order to deliver this property to Mr. Ford the U. S. Government would be compelled to acquire from the Alabama Power Company the right-of-way for the 88 mile transmission line.

VI. The Alabama Power Company offers to give the Government free of charge the second 100,000 horsepower developed at Dam No. 2. This part of the company's offer has no counterpart in Mr. Ford's proposal. On the other hand, Mr. Ford makes a rather indefinite offer to operate Nitrate Plant No. 2 to capacity in the manufacture of fertilizer, and a very definite offer to maintain this plant in standby condition for the manufacture of explosives in case of war. If the Alabama Power Company's proposal be accepted in its present form the Government will have to pay the expense of maintaining this great plant in standby condition.

VII. Mr. Ford makes the Government the insurer of the Dams, although he proposes to pay certain fixed sums to the Government for the maintenance of the Dams. The Alabama Power Company agrees to maintain the Dams at their own expense, and does not require any such insurance responsibility to be accepted by the Government.

The Changed Situation

The injection of this new proposal is bound in time completely to change the aspect of the Muscle Shoals proposition. From the viewpoint of the chemical industries, as we see the situation, the proposal of the Alabama Power Company does not remove the [illegible] threat of Government competition or Government-subsidized competition at Muscle Shoals. This threat is the great vice of the Ford proposal. To a certain extent the same vice inheres in the proposal of the Alabama Power Company. The latter would place in the possession of the U. S. Government, free of charge, for use by itself or its nominee in making chemical fertilizer, 100,000 horsepower. It would seem that unless this power be used in the manufacture of fertilizers or munitions of war by the Government or its nominee, the power must go to waste unless the failure so to use the power can be shown to be "due to changes in the art," in which case the Alabama Power Company could purchase the power and distribute it to going industries.

This part of the proposal, in our opinion, should be modified. It is desirable that the water power should be developed, but it is economically unsound that the power should be reserved for a particular use on such specially favorable terms as to subsidize a particular manufacturing operation. If this power should be used for purely experimental purposes by the Government itself, we could see no objection to its being furnished as proposed without any charge, but no such large amount of power will ever be required at Muscle Shoals for experimentation. If it be used by the Government or the Government's nominee for a commercial operation in the manufacture of commercial fertilizer it should be compelled to bear a reasonable charge. Anything else amounts to subsidizing a particular operation in order to enable it to compete on specially favorable terms with existing private enterprise, and involves precisely the kind of paternalism that has led the chemical industry to look askance at other proposals affecting the development of Muscle Shoals.

A Fair Field and No Favor the Fundamental Rule

Congress should have no difficulty in solving the Muscle Shoals problem now that a responsible corporation has proposed to develop the water power at its own expense. All that is necessary in the way of legislation is to amend the law so that this particular development may be dealt with as are all other water power developments. Then let the Alabama Power Company or Henry Ford or anyone else make application under the Federal Water Power Act for the usual 50-year license, acquire the Government's present power property at a reasonable price, and develop the project with private capital as other projects are developed. This will involve no expense whatever to the taxpayers and will be getting the Government out of a business venture into which it never should have entered.

Textile Research

Following upon the April, 1921, meeting of the National Association of Cotton Manufacturers, at Boston, Mass., when the subject of co-operation research in the industry was discussed, progress has been made by the Research Committee in the establishment of research work within the association in virtue of an appropriation to conduct a research and testing department.

Benjamin T. Brooks, chemical Engineer, Mathieson Alkali Works, Inc., on this occasion addressed the association on "Technical Research and the Textile Industry," reported in May, 1921, CHEMICAL AGE.

R. I. Fuller, who has been retained to conduct the research department, is a graduate of the Lowell Textile School. We was later in the underwear manufacturing department of Marshall Field & Co. and resigned to enter the Bureau of Standards, where during the war he was assistant chief of the textile section of the Bureau of Standards. He is resigning his position there as "associate physicist" of the Bureau to accept the new appointment.

Benzoic Acid Standards

By Nathan R. Levy

ORIGINALLY benzoic acid was obtained only from gum benzoin and was used exclusively for pharmaceutical purposes. Any white benzoic acid made from this gum was considered as meeting all requirements. Later the chlorine process for making benzoic acid was developed and also, closely following it, the use of benzoic acid and sodium benzoate as food preservatives.

With the appearance on the market of synthetic benzoic acid by the chlorine process, a study was made of the impurities present in this product and it was found that chlorbenzoic acid was normally present, and further, that it was objectionable both from the physiological standpoint and because it gave an added odor and taste to food products. Accordingly, the pharmacopoeia of the various countries required that benzoic acid used for pharmaceutical purposes should not contain more than a certain small percentage of chlorine. In the present U. S. Pharmacopoeia this requirement limits the chlorine content to 0.0709 per cent, which is an amount of chlorine corresponding to 0.313 per cent of chlorbenzoic acid.*

The present-day manufacturer of benzoic acid by the chlorine process puts on the market two grades, the essential difference being that the U. S. P. grade meets the chlorine requirement just mentioned, while the technical grade will carry a higher percentage of chlorine. The percentage in this technical grade will occasionally be much higher. The U. S. Bureau of Chemistry reports† a crude benzoic acid which contains 14.1 per cent of chlorbenzoic acid. This, of course, is an extremely impure benzoic acid. One sublimation of this product yielded a series of acids with chlorine-contents ranging from 0.34-2.53 per cent. Since only one sublimation is carried out in the ordinary manufacturing process, it will be seen that a very impure technical benzoic acid would be the result.

There is at present no U. S. P. requirement as to chlorine in sodium benzoate, excepting the general provision in the preface of the Pharmacopoeia that pharmacopoeia products are supposed to be made from U. S. P. raw materials. If this is followed, then the U. S. P. limit for chlorine in sodium benzoate would correspond to a maximum of 0.268 per cent of sodium chlorbenzoate.‡ Despite this lack of a direct requirement, manufacturers in general, but unfortunately not always, use strictly U. S. P. benzoic acid for the manufacture of sodium benzoate.

Composition of Commercial Samples

Lately, there have been developed other processes for making benzoic acid. Certain of the new products appearing on the market carry appreciable amounts of nitrobenzoic acid, but one of them seems to be entirely free from either chlorbenzoic acid or nitrobenzoic acid.

Analyses of samples of sodium benzoate made from these acids and appearing on the market show the following composition:

Sample	Percentage Sodium Chlorbenzoate	Percentage Nitrogen Content	Equivalent Percentage Nitrobenzoic Acid (Calc.)	Percentage Sodium Nitrobenzoate (Calc.)
A	None	.0232	.326	.311
B	None	.0617	.868	.833
C	None	None	None	None

It will be noted that the percentage of sodium nitrobenzoate found (0.833%) in one commercial sample is more than three times the equivalent limiting percentage (0.268%) of sodium chlorbenzoate made from U. S. P. benzoic acid. It is very questionable whether such a quantity of nitro-compounds should be permitted in a food preservative or a pharmaceutical product. Unfortunately, from the standpoint of standards and uses and the easy recognition of impurities, a contamination with nitrobenzoic acid does not give an objectionable odor and taste when used as a food preservative, as does the corresponding chlorine compound.

Certain purchasers are insisting that benzoic acid for their uses should be free from both chlorine and nitro-compounds and in this connection it is pleasing to note that the benzoic acid standard samples lately being sent out by the U. S. Bureau of Standards are of this purity.

Proper Requirements of the Specification

A proper U. S. P. specification for benzoic acid should limit the amount of nitrogen as well as the amount of chlorine. Similarly, the U. S. P. specification for sodium benzoate should carry chlorine and nitrogen limits. In order to reduce the amount of nitrobenzoic acid and sodium nitrobenzoate to a point as low as that required for the corresponding chlorine compounds, the nitrogen must not be allowed to exceed 0.02 per cent, equivalent to 0.268 per cent of sodium nitrobenzoate. In addition there should be a definite limit to the percentage of moisture permissibly present. The only present requirement is in that paragraph of the preface to the Pharmacopoeia which states that where unspecified it is expected that the percentage of moisture should be less than 5 per cent. A definite maximum of moisture should be specified say 3 per cent. Furthermore, the present assay method for sodium benzoate is not a satisfactory one, since there is no definite limit placed on the amount of free alkali in the original material. There is, however, a minimum limit placed on the alkalinity of the residue left on ashing the sample. In other words, the following mixture would apparently meet the pharmacopoeia requirements and yet it would be obviously a product the sale of which should not be permitted: 90 pounds sodium benzoate, 5.86 pounds sodium bicarbonate, 4.14 pounds of a neutral soluble filler, e.g., sodium sulphate.

Food Preservative Uses Paramount

At the present day no large percentage of either benzoic acid or sodium benzoate is used for pharmaceutical purposes. The large requirement is for a food preservative, this amounting to somewhat more than half a million pounds a year, of which about 85 per cent is sodium benzoate and 15 per cent benzoic acid. The amounts used of benzoates other than sodium benzoate are insignificant. Since the food manufacturer ordinarily specifies that the benzoic acid or sodium benzoate shipped shall be of U. S. P. quality, the pharmacopoeia requirements assume an importance industrially far greater than the use of these materials in medicine would justify. Therefore it is important that the committee in charge of the determination of the revision of the pharmacopoeia give proper attention to the specifications for these products not only on account of their use in medicine but even more on account of their use in food products.

---

*The U. S. Pharmacopoeia, Ninth Revision, provides:

For Benzoic Acid: Benzoic acid not less than 99.5 per cent., dry basis, determined by titration in alcoholic solution with standard barium hydroxide. Melting point, 120 to 122° C. Not over .05 per cent. of ash. Test for readily carbonizable impurities. Chlorine limit as specified. Test for cinnannic acid.

For Sodium Benzoate: Not less than 99 per cent. sodium benzoate, dry basis, determined by ignition to sodium carbonate and titration. A 5 per cent. aqueous solution should be neutral or slightly alkaline to litmus. Absence of heavy metals.

† J. Ind. Eng. Chem. 12, 277-279 (1920).

‡ Cf. article by C. E. Smith on Pharmaceutical Standards for Sodium Benzoate, *Am. Jour. Pharm.* 89, 576-77 (1917).

Manufacture of Acetic Anhydride

While it has heretofore been proposed to make acetic anhydride, $(CH_3CO)_2O$, by reacting on a suitable acetate with sulphur chloride (see German Patent No. 132,605), this method of manufacture has since been superseded by other methods, the more modern of which will be found described in Worden's "Technology of Cellulose Esters" (Vol. VII, pp. 2526 et seq.). The principal of these more modern processes is that of Goldschmidt, who, in his German Patents (Nos. 222,236 and 241,898) points out the deficiencies in the older method above referred to.

Charles J. Strosacker of Midland, Mich., has found that by proper manipulation, and particularly by proper control of the temperatures and pressures employed in the process, such older method, consisting, as stated, in reacting directly with sulphur chloride on a suitable acetate, may be made a commercial success. Obviously, in view of the greater convenience in handling sulphur chloride, instead of the reagents involved in the so-called more modern processes, this older process is the preferable one.

Procedure

Mr. Strosacker in carrying out his process* adds slowly to 2 parts of sodium acetate in a suitable closed vessel, 1 part of sulphur dichloride, under about 5 pounds pressure, the while maintaining the temperature of the contents at approximately 20° C. Under these conditions, the resultant acetic anhydride does not tend to volatilize to any serious extent, but remains relatively quiescent in the mixture.

The principal reaction is represented by the formula:

$$\underset{\text{Sodium acetate}}{8CH_3COONa_2} + \underset{\text{Sulphur dichloride}}{3SCl_2} = \underset{\text{Acetic anhydride}}{4(CH_3CO)_2O} + \underset{\text{Sodium sulphate}}{NA_2SO_4} + \underset{\text{Sodium chloride}}{6NACl} + \underset{\text{Sulphur}}{S_2}$$

This reaction is practically instantaneous, and is complete as soon as the ingredients have been brought together in the proper proportions as indicated.

As soon as such reaction is complete, vacuum is applied and the mixture gradually heated so as to distill off the acetic anhydride, the temperature being gradually carried up to approximately 110° C., by which time all of the anhydride should have distilled over.

There will be some acetic acid formed incidentally to the distillation stage which requires to be fractioned off from the product, but the amount of such acid is not serious, the formation thereof, as well as of other more baneful intermediate products, such as sulphur dioxide, being almost entirely prevented by carrying out the reaction and distillation under the conditions of temperature and pressure stated.

At the instigation of the American Sugar Producers' Association Congress has been asked to appropriate $10,000 to enable the Bureau of Standards to solve the technical problems incident to the economic situation involved in the decline in value of crude molasses from $20 per ton to where it has become almost unsalable.

"Its manufacture has become a liability instead of an asset, since it is necessary to dispose of a large amount of this material and factories are prohibited from dumping molasses in the waters of streams. During the last few weeks the small quantity of molasses which has found a market sold for approximately $2 per ton or about one-tenth of its normal price.

Patent Office Salaries

Tardy, begudging and inadequate recognition of the needs of high-class technical men employed in the U. S. Patent Office is accorded by the passage in the Senate of the House bill providing increases of salary which save the 10-per cent. bonus, have remained the same since 1848 when, as regards examiners, they were the same as that ($2,400) of congressmen, now $7,500.

The Commissioner's salary is advanced from $5,000 to $6,000; the National Research Council recommended $7,500. The five members of the Board of Examiners in Chief are to receive $5,000 instead of the present $3,500. Principal examiners are advanced from $2,700 to $3,900. Assistant examiners' salaries are increased by from $150 to $900. Two examiners of interferences are advanced from $2,700 to $5,000; and five law examiners from $2,750 to $4,000. Eight chiefs of clerical divisions are advanced to $2,500 from $2,000. Clerical salaries, at present the lowest in the federal service, are raised to $1,100 from $720.

When we consider the important rôle played by the Patent Office in the development of American industry and that its maintenance is without cost to the taxpayer, in fact having turned into the government in the course of its history over $8,000,000, the neglect and niggardliness of Congress are most deplorable. The present demoralization in the service of the Patent Office will be checked by these provisions, but will not in any way minimize the prolonged affront to American industry.

Friends of Professor Charles F. Chandler presented in 1910 to the trustees of Columbia University a sum of money which constitutes the Charles Frederick Chandler Foundation. The income from this fund is used to provide a lecture by an eminent chemist and to provide a medal to be presented to the lecturer in further recognition of his achievements in science. Previous lecturers on this foundation were L. H. Baekeland, Sc.D.; W. F. Hillebrand, Ph.D.; W. R. Whitney, Ph.D. and F. Gowland Hopkins, Ph.D.

The lecturer this year will be Edgar Fahs Smith, formerly professor of chemistry at the University of Pennsylvania, now President of the American Chemical Society. Dr. Smith's subject will be "Samuel Latham Mitchill—a Father in American Chemistry." Samuel Latham Mitchill was the first professor of chemistry at Columbia College and the first senator from the state of New York. The lecture will be in Havemeyer Hall, Columbia University, on March 2, 1922, at 8:15 p. m.

The Summer meeting of the American Institute of Chemical Engineers will be held at Niagara Falls, June 19-22. Headquarters will be at the Clifton Hotel. This hotel is beautifully situated on the Canadian side just below the Horseshoe Falls. One day will be spent in Buffalo visiting the industries in that locality. Another day will be devoted to a lake trip to Toronto, Canada, and inspection of the chemical plants in that vicinity.

A symposium on Acid Manufacture is being arranged which will include the manufacture and concentration of sulphuric, nitric, hydrochloric and phosphoric acids. A number of excellent papers have already been promised. Members who are familiar with developments along this line are urged to contribute papers.

Papers are also requested on other phases of chemical engineering. Members should advise early the secretary, Dr. J. C. Olsen, Brooklyn, N. Y., of any papers which they may be able to present at the meeting so that ample time may be allotted on the program for reading of the papers and their discussion. It is also very desirable that copies of the papers be sent to the secretary early enough for advance printing.

---

*U. S. Letters Patent No. 1,40[illegible] granted Jan. 17, 1922, and assigned to the Dow Chemical Co.

LHBaekeland

Dr. Leo H. Baekeland

Research Chemist—Chemical Inventor—Creator of Two Great American Industries

CHEMICAL
AGE

Volume 30
Number 2

February
1922

A Consolidation of
The Chemical Engineer
and Chemical Age

EDITORIAL

SPECIALIZED capacity, a cause and a result of our industrial system, involves a sacrifice of adaptability when for any reason the channels of employment run dry of opportunity. The extreme specialization of chemical vocations has conduced to the economic helplessness of their practitioners, felt with especial hardship by older men when compelled to turn to less familiar fields, and by great numbers when caught in the back-wash of depression.

The present period of unemployment, during which chemists have suffered with all the help, has been fruitful of scrutiny of their status as industrial workers. While the situation is not one of such severity as to warrant official importunity for prayer in their behalf, it has convinced thousands of the class that present and impending conditions demand organized study of the class, that its problems and potentialities respectively may meet with a measure of solution and encouragement.

Slowly but surely is the chemist's strong individualism giving way to the conviction of the need of a professional economic organization to study the material problems of the class and to perform the multitude of functions that occur to those familiar with the work of professional societies of lawyers, doctors, plumbers, chemical engineers, nurses, teachers, embalmers, dentists, clergymen, accountants, etc. Such activity as is here urged is quite in contrast with the helplessness and negation of an official appeal for prayer.

ECONOMIC stability cannot be built on injustice. The oscillation of the balance will be prolonged to the common injury so long as parts are permitted to penalize the whole of society, in the delusion that they are profiting themselves.

Our civilization rests on coal and transportation. Chemists know best the fecundity of coal, while engineers know its place as the source of heat, light and power. Its primary cost is chiefly the labor of mining. For this cost to restrict consumption means to reduce its production and so to lower the miners' real wage.

Our industrial preeminence is based upon transportation at a rate that will encourage its use and promote its growth as an industry. The railroads are owned by the people. Here is a basic industry, with an annual buying capacity of a billion dollars, now powerless to display it, to which Government denies the right to set the price at which it may sell its service or to determine the cost of producing it. Progress and the prosperity of our transportation industry are inseparable; we cannot have one without the other.

We have in America today the banditry of unionized railroad labor, levying tribute on all the processes of exchange from the mine and farm to the factory and home, and constituting the greatest single obstacle to the stabilization of values of all raw materials and manufactured goods. The nation suffers in unemployment and laggard readjustment and in its service to the world, that politicians and union labor may pervert this great, basic instrument of civilization to the dubious profit of a group.

Here is a subject that vitally affects the chemist, for his job and the operation of his plant are a function of this situation.

WASTE elimination is a principle that can be traced through the entire course of organic and social development, from amoeba to man and to the present structure of society. That we consider it so much today is evidence of the rapidity of our material growth and of a social introspection which seeks to relieve the race of some of the evils of our industrial system.

Engineering investigators, who allocate responsibility for waste in industry among the various elements entering into production, have neglected to emphasize the zeal of our jurisprudence to preserve undefiled the principle of competition. We may contrast briefly competition, with its attendant waste natural to the process and for which society pays, and combination, with its conservation and its power to oppress.

Production capacity is always ahead of consumption, with the pressing ideal of 100-per cent. operation to reduce unit costs. Trade associations arise from commercial humanitarianism in the effort to minimize in any particular field the pressure and mortality of the competitive process.

The legality of their functions under the Sherman anti-trust act which is declaratory of the common law, has been questioned, with the result to define their limitations and particularly to condemn such activity as will curtail production, enhance prices or suppress competition. The significance of this judicial attitude lies in the encouragement of larger production units through amalgamation and merger in fields where there is much duplication of effort in production.

The Secretary of Commerce and the Attorney General, in their endeavor to clarify an uncertain situation for the benefit of industry, are agreed that the following functions of trade associations, in the absence of intent to curtail production, enhance prices or suppress competition, are inoffensive from the standpoint of the public interest: Standardization of quality, grades and technical designations; elimination of wasteful processes; prevention of dishonest practices; handling of group insurance; cooperative advertising; promotion of welfare work; cooperative representation on legislative questions and transportation matters; and cooperation with Government bureaus.

Uniform trade labels and uniform cost accounting approach closely to the condemned area of trade association activity and receive not the unqualified approval of the Department of Justice.

CHEMISTRY has been overlooked in the glorification of the salesman, natural in a system that makes distribution a condition precedent to production. There is the commerce of ideas and of personal qualifications equal if not greater in importance to that of goods.

That a chemist can sell himself to a $10,000 job at a time when thousands of his kind are out of work or engaged in non-chemical employment, is worthy of the widest publicity to the end that the qualifications sold may be the subject of emulation and that the job filled may indicate another avenue of development for the chemically trained man.

We are not concerned here with the introduction of contrasts; our purpose is one of praise and congratulation and of hope that Harrison E. Howe will keep himself "sold" as the editor of our Society publication, which is the much more difficult part of the art of salesmanship.

MR. HOWE primarily is a salesman of chemistry, which qualification, connoting familiarity with the market, apparently was determinative in his selection.

Editorship is the salesmanship of ideas and a great deal more. It means leadership which is the ability to command respect, confidence and loyalty through the medium of the printed word. It demands soundness of ideas, clear thinking and that firm grasp of the fundamental verities and of the eternal fitness of things that makes principle paramount to policy and ever puts men above methods.

To the degree that such leadership demands originality, fearlessness to say the right thing because it is right and needing to be said, a deep sense of service to his kind and, lastly but far from least, constructive thought, will the editor make himself a powerful influence in formulating and guiding the thought of his field.

Personal advertising finds no place in such a mental entourage. To the degree that the art conceals the artist and makes his work by general acceptance and approval the common property of his field will the editor fill out to the requirements of his job.

IN the light of these principles, well known to the craft and honored unhappily as much in the breach as in the observance, let us consider the salutatory, official editorial.

Propaganda glorifying the chemist and creating a popular impression that he is a wizard has no effect on economic law that decrees the laying-off first, when sales subside, of the least productive elements of an industrial plant.

"The average business man" is not engaged in chemical manufacture; this vague character keeps a petty shop in the middle of the block. It is the exceptional man today, with its unprecedented uncertainties, who is manufacturing chemicals.

Expenditures for prospective gains flow from surpluses. Banks do not loan money on research prospects in an industry wherein many branches depend for their existence upon tariff schedules yet unsettled.

Chemists must look upon the conditions of their employment from the standpoint of the fundamental principles that govern business. With production abandoned in many cases because goods can't be made to sell at a price that will move them, advice to the chemist to convince "the average business man that he is foolhardy to close his research and control laboratories," is simply inane. The reader is directed to the article on page 57 by F. A. Wardenburg, assistant chief engineer, E. I. du Pont de Nemours & Co., on "Industrial Research Must Justify Itself in Economies."

Teaching the public by newspaper propaganda to appreciate a class is as thankless as it is uncertain in its efficacy. The public is not taught by the exceptional chemist, whose discovery or attainments are paraded in the paper, so much as it is by the chemists it sees in the community. Chemists as a class actually have been embarrassed by a popular expectation that the run-of-mine man is not capable of meeting.

The economic consideration accorded the chemist will be determined by the chemist himself in his service to industry and in his conduct as a citizen. Here we are on solid ground and in a path wherein CHEMICAL AGE has led, viz., the formation of an economic organization of chemically trained men in professional societies along state lines whereby the public may accept the chemist at the valuation he places upon himself.

Teaching the public by newspaper propaganda to appreciate a class with which it comes in little contact in the expectation that it will improve its status and reduce the economic helplessness inherent in its highly specialized functions, is further display of the impracticality characteristic of the chemist outside of work to which his training ties him. God helps those who help themselves!

Use of Inert Gas in Preservation of Canned Food

By Thomas M. Rector

Of Rector-Tenney Co., Chemists and Engineers

THOMAS M. RECTOR
Of Rector-Tenney Co., Chemists and Engineers

NOTHING is more essential to the well-being of the human race than food preservation. And the importance of food preservation increases as our civilization becomes more specialized and complicated. The statement attributed to Napoleon, that an army "travels on its stomach" may well be paraphrased to read "civilization travels on its stomach."

Food preservation in ancient times comprised, principally, storage of seeds and grains, the drying, smoking and salting of meats and perhaps the drying of some fruits and vegetables. In the early part of the nineteenth century, however, a radical advance in the art of food preservation was made by Nicholas Appert at the instigation of Napoleon. Appert's work was a wonderful piece of pioneering scientific accomplishment. There is not the slightest doubt that if these principles were followed in detail by modern canners, ninety per cent. of the present commercial canned food would be improved. Many of the problems solved by Appert are causing endless troubles to packers today.

The foundation of the science of bacteriology by Pasteur is another landmark of the progress of the food preservation art. The application of bacteriology to food preservation was productive of such remarkable progress that it was only natural that the possibilities of the science were overestimated. It is only during the last few years that this has been realized. In fact, the realization, even among technical men, does not seem to be general.

The discovery of the "tin can" was of the greatest importance to the art, making possible the establishment of a gigantic industry in itself. Without the tin can as a very practical means of supplying fruits and vegetables, it is very doubtful if our larger cities could have reached their present state of development.

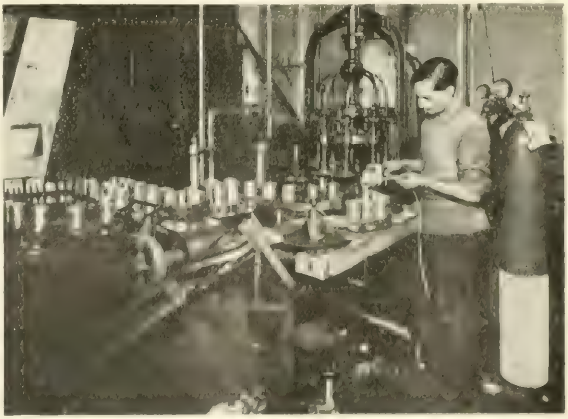
While the art of canning has made great progress in its century of existence, there have been no discoveries relating to it of such fundamental importance as those of Appert and Pasteur. The last twenty-five years have been marked by very important developments, such as the "open-top" or sanitary can, scientific inspection and control work in several branches of the industry, improved processes, etc.

Within the last few years it has dawned upon many food chemists that many of the flavor changes in foods have been due to oxygen in the container. This realization has resulted in active steps to eliminate this undesirable element. Among these steps have been such expedients as venting the cans after heating and sealing while hot; running the cans through a steam chest or "exhaust box" and sealing; and several other modifications of the vacuum process. None of these methods have been entirely successful chiefly because they were only from 50-80 per cent. efficient in removing oxygen. It also appears fundamentally unsound to expect a comparatively frail container, made on a quantity basis, to stand a pressure of 5-14 pounds per square inch for an indefinite time without leaks.

The substitution of inert gases for the oxygen in certain food products has often been suggested, but until very recently does not appear to have been put to practical account.

The first product to be packed by the new process on a commercial basis is canned coconut. The development of this product over a period of nine years is a story in itself. However, it will be sufficient to state here that the experiments for the first seven years on this product were uniformly unsuccessful on account of corrosion of the container and loss of flavor of the product. By the use of inert gases a canned product was finally developed which enables the packer of this product to offer to the public a moist, sweet coconut with flavor unimpaired ready for use in a tin can.

The success of the process on such a difficult product as coconut, has led to a great deal of research work, with the purpose of finding out the effect of various inert gases on other foods. The results of this experimental work have been so encouraging that several packers of such



Commercial installation of [illegible] process for canning shredded coconut [illegible] exhausted [illegible] cans per [illegible] and [illegible] drawn by vacuum pump. By an ingenious combination of poppet valves connection between pump and cans is broken and vacuum in the cans is filled [illegible] Note [illegible] and [illegible] introduced products as coffee, cheese, fish, nuts, fruits, tobacco, confectionery, etc., are considering the possibilities of the process in their respective lines of business.

Applications of the process have been worked out for both liquid and solid products as well as products containing both liquid and solid constituents. In some of the latter class the liquid constituents have been eliminated either wholly or in part, which will result in large savings in freight as well as in the cost of the ingredients of the liquid portion.

The mechanical development of the process has been quite as interesting from the technical standpoint as the chemical and biochemical sides. The credit for evolving practical machinery for the carrying out of the process goes to Dwight Tenney who was obliged to solve many perplexing problems when confronted with the task of removing the air from many thousands of containers and filling them efficiently and cheaply with gases. It is especially worthy of note that the second machine built by Mr. Tenney has been operating practically to capacity in a commercial installation for fifteen months.

The advantages of packing food products in inert gases may be summarized as follows:

1. Practically all oxygen is removed from the container, doing away with any alteration of flavor of product and appearance of the container from this source.

2. The interior pressure of the can is adjusted practically to atmospheric pressure, relieving the seams of the can from strain and enabling packers to use lighter tin plate.

3. Corrosion and pin-holing where due to oxygen are, for the most part, done away with.

In addition to these positive advantages, many other possibilities, such as improvement of flavor by the gases used and the preservation of vitamines and other food accessories, are indicated.

It seems a rather remarkable fact that food technologists and chemists have so long left almost out of consideration the entire gas phase in its relation to food preservation. This would seem to the writer to be a particularly fine field for pure research as well as technical experimentation. The opportunities for work of the highest character are certainly unlimited.

American Institute of Chemistry

OUR correspondence with chemically educated men in all parts of the country engaged in the training of chemists, in the work of production of chemical goods and in their distribution and use, and who represent the three grand divisions of chemical activity, viz., that of the teaching chemist, the production chemist and the business chemist, can be resolved into the following summary:

That our discussion of the segregation of chemically trained men in a way to comport with the needs of the time should be continued; that the candor of such discussion is most refreshing; that it is an essential part of the educative process which if it does not result in the form of organization which we advocate can not help but orient the chemically trained mind to a form that will be a compromise among the great number who see the need of economic organization among industrial chemists; that an economic organization of chemists looking to the inculcation of standards of capacity and to the endowment of a great class of technical men with a defined professional status, is a positive eventuality which is delayed only by the influence born of ulterior motives in contradistinction to those concerned with the open and above-board development of the class as a whole.

For the purpose of this discussion we will divide chemically trained men into two classes, viz., (1) those who have arrived, and (2) those in process of arrival. The former class embraces the older men of the three types of chemists, who in various positions in the educational and industrial work of chemistry, are satisfied with things as they are either because they have participated in the creation of the present arrangement, or because for commercial reasons they want things that way, or because of the aversion to disturbance of a settled system that has required much time to evolve.

Those Who Have Arrived

A prominent member of this class has stated: Economic organization of chemists along lines that we have advocated for the past year is absolutely sound, but it must be created by the younger men; that it does not involve any division of loyalty to our embracing scientific organization membership in which means nothing to the public as indicia of capacity; that employing chemists who say they want to be the judge of capacity ignore the fact that such attitude never can be denied the man who hires another and close their eyes to a natural desire of men to improve their breed and give it a place in the stud-book of the great technical professions; that he, at his age, "can not ride two horses at once" and so disturb his business and social connections with men whose resentment he would arouse if he openly advocated anything that they felt would disarrange the "system."

The success that has attended the efforts of Canadian chemists to dignify their vocation as professional and to demand public recognition of it in a way to reflect the utmost credit upon the practitioner, merits the commendation of all American chemists, however much it may be mixed with chagrin that the chemical professional organization of a sister state that can muster only a maximum membership of about four hundred sets the pace for America whose similar organization readily could muster about four thousand and which could maintain the same cordial, complementary relations with existing scientific organization as does the Canadian professional society.

A great desideratum in the development of American chemical enterprise is popular education in its importance to the very life of the nation. Chemically controlled enterprise is not sectional but has become nationwide in its expansion and in its basic service to society. The intimacy of chemistry's relation to individual well-being, and the growth of chemical enterprise in every state of the Union, easily make practicable and desirable the organization of state chemical societies embracing all identified with chemical enterprise, whereby it may be aligned, as its separate importance well warrants, with other organized activities of the state.

Here we have the instrument *par excellence* of popular education in chemistry in comparison with which the scientific organization's clip-sheet for newspapers, with its content of highly uncertain availability, would be as a whisper to the roar of a tornado.

In such state society, naturally functioning with the maximum efficacy where chemically controlled industry is most prominent, we would have that democracy of organization most responsive to the aspirations of its constituents and providing logically the environ for that segregation of capacity demanded by the state professional society of chemically educated men.

This form of chemical organization, with a field of usefulness limited only by the ambitions of its members, impresses everyone interested in the development of his kind and moves him to confirm the opinion, anonymously quoted, that it must be the creation of the younger generation of chemists.

Those in Process of Arrival

Let us consider the attitude of the members of the latter of the two groups into which we have divided chemically trained men for the purpose of this discussion, viz., those in process of arrival.

Present philosophy emphasizes, as never has been done before, the age-old dictum of human experience that the individual's growth is predicated on the measure of his helpfulness to others. This must be taught. Its beneficence does not flower unnurtured.

There are men and groups of men in American chemistry who would discourage and condemn the aspirations of the younger generation of their kind, because in their selfish conservatism they are disposed to feel, in the face of experience to the contrary, that organization independent of their heart's desire bears the seeds of some sort of evil.

The only "evil" discernible to the increasing number who are giving this subject thought is the absence of centralized control in the hands of a few, in an economic organization dedicated to increasing the usefulness of chemically trained men and to insuring growth and equality of opportunity.

Let us quote, again anonymously, the observations of capable young men whose early attainments indicate a high measure of assurance of growing prominence.

One says that the proposal of state chemical societies, with state professional organizations growing out of them, is the clearest-cut, most sensible movement in American industrial chemistry and promises more than anything that has been proposed since chemistry entered politics to put this sort of enterprise where it belongs in popular estimation. "The antagonism of those with us who feel that chemically trained men are not to be trusted with an instrument of development independent of our scientific society gives us time to watch what the New Jersey Chemical Society is doing."

Another says that he heartily is in favor of a professional organization of chemists but the man under whom he took his doctor's degree, and for whose recommendation he is indebted for his job, is opposed to it because he feels that the scientific organization should satisfy, as it does him, all the instinct of segregation that a chemist should be expected to gratify. "If I openly espouse what I sincerely believe, I would alienate the interest of those on whom I depend for advancement. This is too big a price to pay for open advocacy of what I believe is right. Let others do it and later I'll join them."

Another says: "An economic organization of chemists along state lines designed to promote their material interests in a way to combine the educational institution with the industrial plant and to rank the state's chemical enterprise with other industrial, commercial and financial organizations of the state, is a fine idea and we watch its growth in New Jersey with a great deal of interest. But we have Alpha Chi Sigma which is a professional society to which men prominent in the councils of the American Chemical Society belong. We meet with the American Chemical Society and because of community of membership Alpha Chi Sigma, which name is formed from the Greek letters of the initials of American Chemical Society, is substantially an integral part of it. It is the professional fraternal organization of the American Chemical Society, albeit a secret society."

The consensus of opinion of many others is: We need economic organization as distinct from scientific organization. It is bound to come for the material problems of the work of chemically trained men, beginning in the institution and leading into all branches of chemically controlled industry, are becoming too numerous and too pressing to delay much longer their organized study. This function is incompatible with that of a scientific society and to seek to add it to those already performed by it, with varying measure of satisfaction, promises no solution.

A Precedent and Anomaly

In this connection we direct the reader to the article entitled "The Institute of Chemistry of Great Britain—Some History of Chemical Organization in Great Britain and Some Comparisons," in CHEMICAL AGE, August, 1921, in which we showed the direct analogy of present American conditions with those attendant upon the formation of the British professional organization of chemists forty years ago.

We already have discussed the anomaly in American chemistry of the functions of a college fraternity, projected into the industrial relations of maturity, to serve as the professional organization of American chemists. However worthy such organization may be and however intertwined it may be with our scientific society, to hold it out as the professional section and sufficient to satisfy the aspirations of American chemists is a parody.

The State Chemical Society and the Professional Organization

The state chemical society, promoted and controlled by the respective state professional section of the American Institute of Chemistry, with student sections in every institution of technical education within the state, serving as an arm of the government of the state and as a servant of the chemical industry of the state, with its purposes and proceedings open and above-board, with federation into a national organization—such a system of economic segregation of chemically trained men, clear-cut, common-sensed, democratic and dedicated to the promotion of chemical industry by advancing the welfare of its chemically trained administrators, will meet all the requirements of an increasingly unsatisfactory situation, which are ignored today.

Why are they ignored? Because the formation of an economic organization of chemically educated men in industry, to study the material problems of educated chemical workers and to inculcate standards of capacity in a professional society, lacks courageous leadership.

How has such a peculiar situation arisen? Suffice it here to say that it is the direct consequence of a type of organization and control, based upon individual contributions with Star Chamber methods and secret fraternal inner relations that only can make men cowardly and fearful of their individual progress should they seek to do what their heart and head impel.

Consequent upon the resolutions of the conference for the limitation of armaments abolishing the use of poison gas as an instrument of warfare, the Chemical Warfare Service, U. S. A., under an eventual change of name, will seek to develop industrial uses for poison gases; e. g., in connection with the Treasury Department in perfecting devices for fumigating ships with hydrocyanic acid gas, with the Public Health Service in the use of phosgene in rodent extermination, and with the Agricultural Department in the mitigation of animal, bird and insect pests.

Production and Industrial Uses of Silica

By Raymond B. Ladoo
Mineral Technologist, U. S. Bureau of Mines

SILICA, or silicon dioxide (SiO_2), occurs in a free state chiefly as quartz, by hydrous silica (amorphous silica carrying a variable amount of combined water, 2 to 13 per cent.), occurs as opal, flint, diatomaceous earth, tripoli and so on. Quartz is found in many forms, the most important of which are: As vein quartz; quartzite; sandstone; silica sand and gravel; as crystals or crystalline grains, masses or aggregates in igneous rocks such as granites, diorites and pegmatites.

Forms of Silica Used Industrially

The various forms in which silica is used commercially (other than the ordinary uses of sand and gravel and structural sandstone) are given below:

1. Massive crystalline quartz (vein or pegmatite).
2. Quartzite.
3. Sandstone.
4. Flint or chert (massive or as rounded pebbles).
5. Tripoli.
6. Diatomaceous earth.
7. Silica sand.

These types of silica may be used in several ways:

a. In massive form roughly broken to size. Example: massive quartz for acid tower packing.
b. In massive form cut to definite shape and size. Example: grindstones and diatomaceous earth brick.
c. In original state as pebbles. Example: flint grinding pebbles.
d. In original state as grains. Example: glass sand and filter sand.
e. Crushed to coarsely granular form. Example: quartz grain for sandpaper.
f. Ground to fine powder. Example: ground flint for pottery manufacture and ground diatomaceous earth for polishing powder.

Ground silica appears on the market under the names of silex, flint and silica, regardless of the original form of the material, as well as under the true mineralogical names.

Occurrence and Production

Free silica in its varied forms is very widely distributed, forming one of the most abundant constituents of the earth's crust, but deposits of commercial value are far less common. However, with the exception of such relatively scarce materials as tripoli and flint grinding pebbles, most forms of silica are sold for such low prices that economic factors, such as proximity to railroads and to local markets, govern the value of a deposit. Thus deposits of glass sand may be valueless if located far from supplies of cheap fuel and far from large centers of consumption for glass.

Mining and Milling

Methods of mining the various siliceous materials vary widely, dependent on the form of the material, nature and location of deposits, and type of product to be made. However, most of the deposits are worked by open-pit or quarrying methods, often in a very crude way. Sand deposits may be worked by hydraulicking, by dredging or by the use of a steam shovel. Vein quartz is often obtained as a by-product in the mining of other materials. Pegmatite quartz is almost always obtained as a by-product in working pegmatite dikes for feldspar or mica.

No true flint is mined in this country either for grinding pebbles or for ground flint, and all flint marketed is imported, chiefly from Europe. Much of the material sold to the pottery trade as ground flint is either ground quartz or ground sand, although considerable true flint is ground in this country, chiefly for ceramic purposes.

In the grinding and preparation of silica for market several methods are in use, dependent upon the type of raw material, the character of the product desired, and the progressiveness of the producer. For ceramic use silica is ordinarily ground to pass through a 140-mesh sieve, but for paint, polishes, fillers, etc. much finer grinding is necessary, a 200 or even 300 mesh product being required. For sandpaper much coarser grains are needed and these grains must be carefully graded by size.

Massive flint and crystalline quartz are very hard and tough. Crushing the crude rock is difficult and expensive, and to obviate this it is often calcined before crushing. Calcination is usually done in a small vertical kiln, resembling a lime kiln, fired with wood or coal, in which are placed alternate layers of rock and fuel. As the fuel burns away the charge slowly sinks in the kiln, the heated rock being removed at the bottom and quenched with water. The calcined rock may then be broken down by hand, and fed to "chaser mills" or crushed in jaw crushers, possibly followed by chaser mills.

Fine grinding may be done either wet or dry. Wet grinding may be accomplished in conical mills, short tube mills, in the long tube mills or in wet grinding pans. If a wet grinding process is used the finished product is usually sized by some system of water classification. Dry grinding may be done in conical mills, short pebble mills of the intermittent type or long tube mills. In dry grinding methods sizing of the finished product is not common, but in some instances air separation may be used. The wet ground product may be dried by steam in open tanks or over steam-pipe racks or in rotary driers.

The present tendency is toward grinding less flint and vein quartz and more glass sand, loosely consolidated sandstone and tripoli, on account of the high cost of pulverizing the massive forms of silica.

Specification and Tests

Very few standard specifications and tests exist for finely ground silica, but most products are sold on sample. For ceramic use most consumers require a product 99 per cent. of which will pass through a 140-mesh screen. They also require that the iron-content be very low (sometimes less than 0.05 per cent). Amorphous silica in the form of ground flint is often preferred by the pottery trade. For paint and for fillers a 200-mesh product is usually required, although for some uses a product as fine as 350-mesh is demanded. Angular grains are often preferred to rounded grains for use in paint and fillers. For abrasive purposes the grain size varies from a coarse sharp sand (for coarse sandpaper) down to an impalpable dust (for fine polishes). It is important that abrasive silica have sharp angular grains, rather than rounded grains.

Utilization

The principal uses for silica are tabulated here, together with the more common forms of silica now used for each.

USES OF SILICA	TYPES OF SILICA USED
Abrasive Uses	
In scouring and polishing soaps and powders.	Quartz, quartzite, flint, chert, sandstone, sand, tripoli and diatomaceous earth; all in finely ground state.
In sandpaper.	Quartz, quartzite, sandstone and sand; coarsely ground and closely sized.
In sand blast work.	Quartz, quarzite, sandstone, and sand, crushed into sharp angular grains uniform in size.
For sawing and polishing marble, granite, etc.	Sharp, clean sand graded into various sizes.
As whetstones, grindstones, pulpstones, oil stones, etc.	Massive sandstone from very fine to moderately coarse grained.
Tube mill lining.	Chert, flint and quartzite in dense, solid blocks.
Tube mill grinding pebbles.	Rounded flint pebbles.
In tooth powders and pastes.	Various forms of pure silica finely ground.
Refractory Uses	
In making silica fire brick and other refractories.	Fairly pure quartzite, known as gannister; not less than 97% SiO_2 nor more than 0.40% alkalies, tightly interlocking grains desired.
Metallurgical Uses	
In making silicon, ferrosilicon and silicon alloys of other metals such as copper.	Moderately pure sand and massive crystalline quartz.
As a flux in smelting basic ores.	Massive quartz and quartzite.
Foundry mold wash.	Ground sandstone and quartz.
Foundry parting sand.	Fine sand and ground tripoli.
Chemical Industries	
As a lining for acid towers.	Massive quartz or quartzite.
As a filtering medium.	Massive diatomaceous earth and tripoli, sand, finely granular quartz or quartzite, finely ground tripoli, diatomaceous earth and other forms of silica.
In the manufacture of sodium silicate.	Pure quartz sand.
In the manufacture of carborundum.	Pure quartz sand.
Paint	
As an inert extender	Finely ground crystalline quartz, quartzite and flint often preferred; also finely ground sandstone, sand and tripoli.
Mineral Fillers	
As a wood filler.	Finely ground crystalline quartz, quartzite and flint preferred, but all types of ground silica used.
As a filler in rubber, hard rubber, ground and molded [illegible], phonograph records	Finely ground silica of all types.
Ceramic Uses	
In pottery industry as ingredient of bodies and glazes.	Flint and chert, and other amorphous silica preferred; [illegible] other forms of very pure silica, all finely ground.
In the manufacture of ordinary glass	Pure quartz sand
In the manufacture of fused-quartz chemical apparatus, such as tubes, crucibles and dishes.	Very pure massive quartz preferred.
Decorative Materials	
In manufacture of gems, crystal balls, table tops, vases, statues, etc.	Rock crystal, amethyst, rose quartz, citrine quartz, smoky quartz, chrysoprase, agate, chalcedony, opal, onyx, sardonyx, jasper, etc.
Insulation	
Heat insulation for pipes, boilers, furnaces, kilns, etc.	Massive and ground diotomaceous earth.
Sound insulation in walls, between floors, etc.	Massive and ground diotomaceous earth.
Structural Materials	
Sand-lime brick.	Moderately pure sharp, angular sand, preferably finer than 20-mesh.
Optical quartz	
For the manufacture of lenses and accessories for optical apparatus.	Clear, colorless, flawless rock crystal or massive crystallized quartz.

First Steps Toward Organization of the American Institute of Chemistry in New Jersey

As a first step toward the formation of the American Institute of Chemistry registration blanks have been forwarded to all New Jersey chemists. The *Bulletin* of the New Jersey Chemical Society urges all New Jersey chemists to fill out and return promptly these blanks which will serve as an initial enrolment. The character of the response will determine the measure of hospitality with which the project is entertained.

As is now generally understood by American chemists the economic organization looking to the inculcation of professional standards in chemistry must be by states with such subsequent federation as the progress of the movement may warrant.

As New Jersey is the only state in the Union at the present time which has an independent organization for all identified with chemical enterprise within the state, it provides the first requisite, which is a state organization, from which may be segregated in an affiliated and directing organization those desirous of recognition on the basis of professional status.

The professional state organizaton of chemists, which would be the respective state section of the American Institute of Chemistry, is grounded in two aspects of service, viz., (1) to the individual by studied application of the principle of natural selection and (2) to the state by the organization of all identified with chemical enterprise within the state, regardless of academic and experiential qualifications, whereby the state's chemical industry may align itself with all other organized activities of the state.

Here is an instrument of chemical education unmatched in efficacy. The individual's development is determined by the measure of his helpfulness to the state in the promotion of its chemical enterprise in whose progress lie his own fortunes. The economic soundness and desirability of this method, however apparent it may be on its face must be demonstrated by participation in it. The enterprise of New Jersey chemists in seeking to do something for themselves will be watched with much curiosity by chemically educated men everywhere.

The Factory Chemist and the Urge for More Business

The Duplication of Competitors' Products and Its Legal Limitations in Sales Policies

ONE of the duties of the factory chemical laboratory is the analysis of competing products, where information as to character or approximate composition cannot be disclosed to the experienced man by inspection. From the chemist's report a formula may be deduced which is at once comparable with that used in the plant. This is a common process in the strife to maintain or improve existing quality of one's products over that of a competitor's.

Such process involves no infringement of any right claimed by another making the same product under a proprietary name. But duplicating the product, giving it a name suggestive of one of established repute and offering it to the trade as the same or just as good at a lower price, is commercial piracy from which the courts will grant relief.

Eli Lilly & Co., manufacturing chemists, Indianapolis, Ind., made "Coco-Quinine," a liquid preparation with quinine as the therapeutic agent; yerba santa was used to disguise the bitter taste of quinine, with chocolate syrup as a coloring and flavoring agent. This was the first liquid preparation of quinine sulphate with the taste of quinine disguised and the first of many similar preparations to be colored and flavored with chocolate.

In the usual process of trade in pharmaceuticals, salesmen procured the approval of physicians who came to prescribe it and druggists, on the other side, began to stock it and in course of time a profitable trade grew up.

Later the Pfeiffer Chemical Co. manufactured and Wm. R. Warner & Co., distributed a compound called "Quin-Colo" identical in color, taste and composition with the Lilly product. In competing for the retail drug trade Quin-Coca was not passed off for Coco-Quinine but was offered on the representation that it was the same and could be used as a substitute for Coco-Quinine.

Injunction Denied

Eli Lilly & Co. sought to enjoin the activity of the manufacturer and distributor of Quin-Coco, claiming the sole right to use chocolate as the distinguishing ingredient of its product. Injunction was denied on the ground that, as Eli Lilly & Co. does not manufacture its product under a patent, and as it has no exclusive right to the use of its formula or to any of its ingredients, the preparation may be made by anyone who, in good faith, acquires knowledge of its composition, and may be sold in open commerce on his representation that it is the same as the plaintiff's preparation. (*Hostetter* v. *Fries,* (C. C.) 17 Fed. 620.)

Thereupon, the court held that the Wm. R. Warner & Co. did not engage in unfair competition in using chocolate for the color and flavor of its preparation. It also held that Eli Lilly & Co. had acquired no common-law trade-mark in the words Coco-Quinine, they being merely descriptive of the contents of the mixture, and that, in consequence, it could not complain when the defendant used practically the same words transposed to describe the same things.

Decision on Appeal

The Circuit Court of Appeals confirmed the decision of the trial judge that although Eli Lilly & Co. conceived the name Coco-Quinine and gave it a substantial commercial value, as evidenced by the large trade built upon it as well as by its almost literal appropriation by Wm. R. Warner & Co., the name is, nevertheless, but descriptive of the ingredients in the compound and, therefore, cannot become the subject of trade-mark.

The Appellate Court affirmed the principles of the law of unfair competition invoked by the trial judge but differed with him as to its application to the controlling facts of the case which called into operation but one principle of law.

Procedure of the Duplicator

The Pfeiffer Chemical Co. and Wm. R. Warner & Co., realizing that Eli Lilly & Co. had no exclusive right to the formula of its preparation, duplicated it by a preparation of its own and offered it to the trade in competition, as it had a right to do. But the trouble is with the manner in which they did it.

They first procured samples of the Lilly preparation. Learning its ingredients, they then proceeded to make the same preparation. Their efforts were expended not so much in making a compound that would act like Lilly & Co.'s as they were in making a compound that would look like it and taste like it. They did not show the concern for the use of chocolate as a medium of color and taste that they showed in finding a chocolate that would give to its mixture the color and taste of the plaintiff's. In their laboratory they conducted experiments with chocolates of different kinds in an effort to get the precise color and taste derived from the chocolate used by Lilly & Co.

For a time they were not successful, but eventully they succeeded. They then placed the product on the market. They did not send salesmen to prescribing physicians, presenting to them the merits of the preparation and soliciting their favor in prescribing its use as did Lilly & Co., but they sent their salesmen directly to druggists and represented to them that Quin-Coco is the same as Coco-Quinine (referring to the latter by trade name and maker's name); that when Coco-Quinine is prescribed by a physician or asked for over the counter by a customer, Quin-Coco could be "substituted without detection" and "without anyone being the wiser."

Salesmen would at times pour both mixtures on paper to demonstrate the identity of colors. To induce druggists to make purchases Wm. R. Warner & Co.'s salesmen represented that substitution of Quin-Coco for Coco-Quinine was not only practicable but profitable because Quin-Coco was cheaper.

Consideration of the Facts

The first question is one of fact — whether it is fraud for a druggist to substitute a drug for the one called for by a physician's prescription or by a customer directly. That substitution of drugs is fraud upon the consumer, who, from the very nature of the transaction, is helpless to protect himself, is so obvious as to require no discussion.

For the protection of those who are exposed to the dangers of such fraud, courts will exercise to the utmost all the resources of the law. We have no doubt, says the Appellate Court, that the substitution of Quin-Coco for Coco-Quinine extensively practised by druggists amounted to fraud and of the same opinion were a number of the very druggists who practised the deception. This then was fraud, but it was the fraud of druggists.

Consideration of the Law

The next question is one of law—whether in counseling such fraud and in supplying the means with which to effect it (that means being in itself quite innocent) the Warner Co. also was guilty of fraud. Put in this way the question is not whether the Warner Co. can be held responsible for the fraud of third parties, the ultimate sellers, (Hostetter v. Fries, (C. C.,) 17 Fed., 620), but it is whether in counseling fraud and in supplying an innocent means with which to bring it about Wm. R. Warner & Co. has itself committed fraud. This question turns not alone on the character of the means.

Admittedly the Lilly Co. has no monopoly in its formula nor has it an exclusive right to the use of any of the ingredients. This leaves the Warner Co. and everyone else free to duplicate Lilly & Co.'s preparation and enter the trade in competition, if, in so doing, they do not infringe the right of consumers not to have passed off on them the product of one maker as the product of another.

This right resides in the public without regard to whether the party for whose goods another product is passed off has or has not a monopoly in them or an exclusive right to use certain of their distinguishing ingredients. A customer has a right to get what he calls for and pays for.

Precedents in Soap and Soft Stuff

If the effect of a practice is to deceive an unwary customer and lull him into the belief that he is getting what he asked for when in fact he is getting something else, the practice is illegal because a fraud upon him. And this is so (certainly where, as in this case, the purpose as well as the effect was to deceive the consumer) even when the dress or get-up of the substituted preparation is open to use by everyone.

Thus in the case of *Lever* v. *Goodwin* (57 Law Times Reports, 583, 4 R. P. C., 492) the plaintiffs put their soap into wrappers of imitation parchment paper (which was then not a common thing), and printed (which was unusual) some letterpress on it in spaced or broken type. The defendants put up their soap in wrappers of imitation parchment paper, and they also printed on the wrappers letterpress in spaced or broken type.

Their letterpress was quite different from the plaintiff's, and the defendants' name appeared in capitals four times among the letterpress, but the court found that though the printing was wholly different, the effect of the get-up was to mislead the customer, and held the practice unlawful notwithstanding the plaintiffs had no monopoly either in the kind of paper used as a wrapper or in the style of printing appearing upon it.

Of like opinion was the court in *Coca-Cola Co.* v. *Gay-Ola Co.,* (200 Fed., 720; 119 C. C. A., 164, C. C. A. [illegible]), where the defendant used the free agent of caramel to simulate the color of the preparation it was imitating.

Unfair Competition

These English and American decisions are authority not only for the law that the innocence of the instrument of fraud does not *per se* avoid unfair competition, but also for the law that, in applying the instrument (with circumstances which singly would not be unlawful), the defendant cannot avoid responsibility for the part it took in the fraud committed—or completed—by the other. In the Lever case the retail dealer was not deceived in purchasing the product. Neither was he deceived in the Coca-Cola case; nor in this case. The dress of the product in each case as it went to the dealer was entirely distinctive. The evident purpose in each case was to deceive, not the retail dealer, but the ultimate consumer. For the consumer in this case the preparation was rebottled. To him it came, not in the distinctive dress in which it reached the retail dealer, but naked. The only mark it had was that of color, which (as in the Coca-Cola case) the defendant labored to make non-distinctive. Having counseled fraud upon the ultimate consumer and having put in the hands of the retail dealer the means of committing the fraud there is no room for the defendant to shift the blame to the retail dealer and no ground for the defendant to say that it is not answerable for the part which it itself played in the deception of the cousumer. Certainly the defendant was an accomplice, if not the principal in the practice.*

With unfair competition thus established, the Appellate Court held that an injunction should issue restraining Wm. R. Warner & Co., directly or indirectly, from inducing and enabling retail druggists to substitue Quin-Coco for Coco-Quinine. But it is said that such an injunction would deprive the Warner Co. of using, as a coloring agent, an ingredient admittedly free to everyone. That is true, but, as we are deciding this case on conduct rather than on chocolate, we think the defendant has forfeited its right to the use of chocolate as a coloring agent because of its misuse; namely, the double fraud upon the public and a competing producer.

That the Warner Co. may no longer derive advantage from its own fraud by resort to an ingredient the use of which otherwise is lawful, the trial court was directed to award an injunction restraining Wm. R. Warner & Co. and the Pfeiffer Chemical Co. hereafter from using chocolate as a coloring matter in its preparation named Quin-Coco. The only practical way of protecting the public and the Lilly Co. from a continuance of their unfair practices is to deprive them of the ingredient by which alone it made those practices effective.

It should be noted that by this decision Eli Lilly & Co. is not given a monopoly in the use of chocolate. Therefore the injunction restraining the use of chocolate in a liquid preparation where the taste of quinine is masked will extend only to Wm. R. Warner & Co. and the Pfeiffer Chemical Co., whose practises with reference to it have been unlawful.

We are not adjudicating the acts and responsibility of other makers of similar preparations, for with respect to them we have not been informed of wrongdoing—all of which is duly set forth in the recent opinion of Buffington, Wooley and Davis, Circuit Judges of the U. S. Circuit Court af Appeals—Third Circuit—in the case reported in Vol. 275, Federal Reporter at page 752.

Henry Ford's Muscle Shoals bid has been altered to include a definite guaranty to produce fertilizers in finished form at given annual minimum tonnage, to capitalize the operating company and to deliver fertilizer to consumers at profit of not to exceed 8 per cent.

---

*Lever v. Goodwin, 57 Law Times Reports (N. S.) 583, 4 R. P. C., 492; [illegible] C. C. A. 164, 200 Fed. 720; [illegible] C. C. A. [illegible] Fed. [illegible] C. C. A. [illegible] Fed. [illegible] 345, 58 C. C. A. 490; [illegible] 63, 32 Sup. Ct. 20, 56 L. Ed. 92; [illegible] 1915A 1285, 38 Cyc. 778 notes; Cutler on Passing Off.

Injunction Issues

Relation of the Technically Trained Man to the Promotion, Organization and Development of Industry

By L. W. Wallace
Executive Secretary, The Federated American Engineering Societies.

A PROMINENT official of the New York Edison Co. some time since made this important statement: "If those who have written the history of civilization from its beginning down to the present are correct in their conclusions, the greatest forces vital to the progress of the human race are the moral and the intellectual. To be willing to perform our duty is the moral part; to know how to perform it is the intellectual part; while the closer these two parts are knit together the greater the harmony with which they work and the more securely shall we lay the foundation for the further advancement of mankind."

"The intellectual part can be developed only through education. The training must be broad in character and so carried on as to develop the individual mind and inspire the individual to strive for a standard of accomplishment as high as the individual can conceive. Other things being equal the trained mind always excels the untrained mind."

L. W. WALLACE
Executive Secretary, The Federated American Engineering Societies

Dr. W. F. M. Goss in his presidential address to the American Society of Mechanical Engineers some years ago said: "The modern need in the field of engineering is for men who can perform the exceptional task; for men who are safe keepers of their brothers' interests; for men whose qualities of character are so sound and strong that they instinctively perceive the way of truth and follow it; for men whose activity and understanding detect the defects of established practice and find a way to improve that practice; for men who so well understand the fundamental principles of science as to be able to predict the next step before it has been taken; for men, in fine, who can rank with the world's greatest leaders in science and industry."

The key note thought of the two statements is that technically trained men are needed in business and in industry.* However, it is also indicated that the requirements demand men of breadth of vision; men with a grasp of the fundamental principles; men of clear concepts; men whose qualities of character are sound and strong; men who have a passion for public service and a deep and an abiding faith and trust in mankind.

It is a happy privilege to relate that the technically trained men of the United States are more and more fulfilling such honorable and praiseworthy requirements. Technical men today as never before are recognizing their obligations as citizens first and as technical professional men second. This is exemplified by the existence of the Federated American Engineering Societies, which was founded for the purpose of enabling engineers to render public service whenever technical knowledge and engineering skill are involved.

The Scientific Method Standardization

American industry is today characterized by idle men, idle equipment, idle materials and idle plants. The reason for this condition is not entirely apparent. The remedy to be applied is perhaps more obscure.

However, those that have studied the situation closely have a rather clear conception as to the reasons and some fundamental thoughts as to what may be done to materially lesser the ill effects of the present situation. But particularly do they know what principles and practices may be invoked in the future to stabilize the activity of American industry.

The first step is to more largely commit the promotion, organization and development of American industry to technical men—men who through technical education, or through home study have a clear understanding of the principles of science and of engineering and of the science of business and who through years of experience have learned to interpret causes in terms of effects or who can anticipate an effect knowing the cause or action to be applied. In other words if American industry is to fulfill its great opportunity in the commerce of the world it must be promoted, organized and developed by the scientific method.

That this has not been the characteristic of American industry every one knows. One of the important reasons for the present chaotic condition of American industry is that in a large measure it has been dominated by the speculative and by the sales types of managers, instead of the scientific type which analizes, synthesizes and directs in accordance with known principles. As a result of the absence of the scientific method there has been much loose thinking, grievous errors and large economic loss.

In those industries and plants where the technically trained man has had authority and influence is to be found stability and poise instead of instability and confusion. Even in such periods of stress as the present there is to be found constructive progress. An optimism that breeds courage that begets result. In a midwestern city, in a disturbed labor market, amidst high prices and low sales, a prominent plant has been able to reduce its cost of production 25 per cent, increased its output 18 per cent and pay labor 20 per cent less, because the technically trained works manager was able to analyze the various complex conditions and in accordance therewith adjust their policies and practices to meet the conditions.

There are many activities of modern industry that are so complex that it requires a technically trained mind to grasp them and to cope with them. And only men of such training fully can evaluate the significance and influence of many of the essential elements of modern industry—and there are many factors that demand a clear conception if adequate returns are to be realized. It is important to bear some of these in mind.

---

* A paper presented to the Conference on Engineering and Industry in connection with the inauguration of President John Martin Thomas, Pennsylvania State College, October 13, 1921.

Industrial research is not adequately utilized in American industry. It is authoritatively stated that a full-time research man is not employed in one of the important American industries. Many industries have not utilized scientific and industrial research as an aid to increased and to economic production. Great losses are occurring with this realm of the technically trained man. And again there is a mass of valuable information hidden and not being utilized. Information of great value and which has cost hundreds of thousands of dollars to procure. And again there is a large duplication of effort. Many corporation and individual firms are conducting research laboratories and spending large sums on research of like character. The technically trained man is the one that can best grasp such a situation; make comparisons and evaluate the merits of such work. It is inconceivable that such would continue for a very long period if the scientific method were permitted to function. An encouraging example has been set by a group of car manufacturers. Some years ago they organized a research agency headed by an engineer to conduct researches for the group. This agency also standardized many of the methods of manufacture and of cost-finding and other processes of common concern, thus eliminating much duplication and a large area of misdirected effort. In other words, this particular group has adopted the scientific method.

In the matter of standardization, interchangeability and correctness of design, there lie great possibilities. Defects in design and in the work of the untrained designer accounts for a large amount of idle labor and equipment. Incompetent and defective design is also conducive to labor unrest and disturbance. Low production and increased costs are the consequence of poor design. Evidences of such are all about.

The absence of the scientific method also expresses itself in a multiplicity of models, designs or patterns. The industry that has no full-time research man engaged and in which there are to be found very few technical men is a gross offender of all principles of standardization and of design.

In the clothing industry it is a rather common experience to find records like these: (a) 31 models, 17 of which represents 15 per cent of the annual business and 14 models, 85 per cent of the business; (b) 20 models, 9 of which represented 95 per cent of the annual business and 13 models 5 per cent of the annual business. Each model was offered in over 1,000 styles of cloth. That the public does not demand such a great variety is evidenced by 95 per cent of the business going to 9 models.

In the construction industry a like lack of standardization prevails. In a recent survey it was found that in the matter of the thickness of walls there was a wide divergence. In 90 cities, thirty required a 13-inch wall for the first story and 9-inch wall for the second. While the remaining thirty required a 9-inch wall above the basement. Another evidence of economic waste through not adopting the scientific method.

The absence of standardization of method, of policy and of practice in the building and in the clothing industries is one of the fundamental reasons for so much labor unrest and strife. As a result of the non-standardization of every function of the industries named they are the most chaotic of all. This expresses itself in seasonal activity. The clothing industry is only active about 65 per cent of the year and the building industry 70 per cent. It also expresses itself in a large area of labor unrest and disturbance. In 1918 in New York 30 per cent of all the strikes occurred in these two industries.

The scientific method has been applied in small areas of each industry and the results are noteworthy. They clearly indicate that if extended throughout these two very unstable and disturbing industries would soon become marked by their stability.

Personal Relations

In the entire category of personal relations there is a need for the application of scientific principles. In the first place the very acme of the scientific method is to have facts. All action must be predicted upon fact. Yet there is almost a total absence of fact. In such common and relatively tangible matters as unemployment and labor disturbance there is a dearth of fact material. The number of unemployed in the United States today is not known within any approach to scientific accuracy. Likewise, concerning the number, extent and duration of labor disturbances.

The amount of production per day or per hour that is fair and just for virtually all operations performed in industry is unknown. The fair quantity to demand not being known, the wage base for such performance can not be fixed with a fairness to all concerned. The result of such irrational method as now prevails is known to all. Until standards of performance and of remuneration are scientifically determined there will continue to be the labor unrest and disturbance that has characterized American industry in recent years. A rational conclusion or standard cannot be determined without basic facts. Basic facts are derived through the application of scientific principles of analyses and synthesis. In the category of personnel relations there is a grave heed for scientific study and direction.

Transportation

One of the large potential possibilities for saving human effort, materials and capital expenditures is in applying the scientific method to the problems of internal and external transportation.

In recent years important developments have been made in the physical equipment used for internal transportation purposes. Yet there is a large unexplained and undeveloped field in the way of equipment design and more particularly in the adaptation to new uses the equipment now obtainable. In many plants are to be found crude and laborious methods of transportation which mainly demand the exertion of more man power. It is purely the engineers function to correct such conditions. Many examples of accomplishment might be cited. One such example will suffice for the present purpose. In a large railway shop, through the investment of $63,000 an annual saving of $51,000 was realized. This was expressed in a reduction of labor force of 35 per cent; working hours 32 per cent; pay roll 34 per cent.

That the ingenuity, the skill and the scientific point of view of the technically trained man should be given a greater range of action in American industry is clearly portrayed by the findings of the Committee on the Elimination of Waste in Industry. In the foreword to the Waste Report Mr. Hoover states that "We have probably the highest ingenuity and efficiency in the operation of our industries of any nation. Yet our industrial machine is far from perfect. The wastes of employment during depressions; from speculation and over-production in booms; from labor turnover; from labor conflicts; from intermittent failure of transportation of supplies or fuel and power; from excessive seasonal operation; from lack of standardization; from loss in our processes and materials—all combine to represent a huge deduction from the goods and services that we might all enjoy if we could do a better job of it."

In conclusion I wish to remind you that there is a large task before American industry. Large in its inherent economic magnitude; large in its human aspects; large in its political and social possibilities. If this is to be a prosperous nation; a nation of happy people; a nation politically sound and stable; a nation of good morals and high ideals—the chaotic conditions that now prevail and the waste that is now occurring through incompetent management, arbitrary labor and public indifference and connivance must be eliminated. There is no group better fitted by training and experience and by a non-partisan position to undertake the task than the men of the technical professions.

Increased Capacity in Sulphuric Acid Production

By Dr. Charles H. MacDowell

President, Armour Fertilizer Works

HERETOFORE, in the production of sulphuric acid on a commercial scale by the well-known chamber process, the hot gases, containing sulphur dioxide yielded by the burning of sulphur or pyrites, have been passed through a Glover tower in the usual way over the loose packing or filling of which trickles down a mixture of nitrous vitriol from the Gay Lussac tower and weak acid from the chambers in such proportions that they arrive at the bottom of the tower as denitrated sulphuric acid.

The gases now pass on to the large-volume lead-chambers where they meet with steam, or with water converted into a fine spray.

Here the customary reaction takes place whereby the chamber acid is formed, the gaseous mixture flowing on through the Gay Lussac tower, such mixture containing the whole of the free nitrogen of the air which had entered into the pyrites or sulphur burners, together with a portion only of the oxygen originally present therein, such excess of oxygen being required in order to carry out the conversion of the sulphur dioxide into sulphuric acid as completely as possible, traces of sulphur dioxide and some oxides of nitrogen.

In such Gay Lussac tower the sulphuric acid flows down in sufficient quantity to retain the nitrous vapors, the waste gases ultimately being drawn off by a chimney or sometimes by mechanical means.

Reduction of Chamber Space

Many attempts have been made to reduce the chamber space by apparatus intended to bring about a better mixture of the gases, and to facilitate the interaction of the misty nitrous gases and dilute acid floating in the chamber with each other and with the chamber atmosphere. To this end reaction-towers have been placed between the chambers, but, though this and similar apparatus have proved to be useful in the later stages of the process, it has not been found practicable to do away with the lead-chambers entirely.

Since the reactions occur among gases and liquids in a nebulous state, vast spaces must be provided in which the process may be carried out as quickly as possible before the waste gases are allowed to escape into the outer air. Such spaces have heretofore been supplied in the form of large lead-chambers which are relatively expensive pieces of apparatus.

To complete the reaction and to secure the best results, the temperature of the gases should be reduced in the successive chambers by the transmission of heat through their lead walls as the percentage of sulphur dioxide decreases, although the reaction takes place in the first part of the system rather quickly because of the large excess of sulphur dioxide and oxygen, the temperature, and provided, of course, that sufficient water and nitre for the reaction are present.

The time factor is important and to complete the chemical change quickly requires the rapid extraction or dissipation of the original heat of the gases and the heat of the reaction. Accordingly, heretofore, such lead-chambers have been made of a sufficiently large size to conduct away the heat through their metal walls.

Cooling Gases to Facilitate Reaction and to Increase Capacity

One leading aim of my invention* is the provision of means to cool the gases in such chambers comparatively rapidly and efficiently whereby to remove the heat and to facilitate the chemical reaction, by which means the capacity of existing chamber plants may be materially increased, thereby decreasing the cost of production.

Stated otherwise, my invention makes possible the erection of a new plant at a substantially less cost as compared with that of the present day plants of the same capacity.

In the making of sulphuric acid the overhead expense is an important item because of the relatively heavy and expensive installation.

Hence it is highly desirable to be able to cut down such apparatus cost, thereby decreasing the expense of producing the acid.

Accordingly my chief aim is the rapid extraction of the heat from the gases of the lead-chambers and desirably also the provision of sufficient water at the same time for effecting the chemical transformations.

Obviously, water cannot be passed through the lead-chambers as a cooling medium because of the evolution of considerable heat produced by its contact with the sulphuric acid, and, furthermore, the employment of a substantial excess of water for temperature-reducing purposes, even if it could otherwise be so used, would detrimentally dilute the acid produced.

Cold H_2SO_4 Used to Reduce Temperature

I have discovered, however, that sulphuric acid of reduced temperature may be satisfactorily used for its cooling effects in such lead-chambers, and, consequently, I draw off a portion of the warm acid from one or more of the chambers, add enough water to bring it down to about 50° Baumé, cool it, thus abstracting its original heat and that generated by the admixture with the water, and then introduce such reduced cooled acid in the form of sprays into all of the chambers, and in some cases also into the intermediate scrubbers or towers frequently employed between the chambers, at least in the preferred manner of practicing the process, eliminating the use of the ordinary separate water sprays, because the needed water for the reaction is present in the diluted acid.

---

*U. S. Letters Patent [illegible], issued Jan. 10, 1922.

Thus the water of such reduced acid is employed in the production of more sulphuric acid, while the acid of such diluted acid acts simply or chiefly as a cooling agent, keeping the temperature down and hence rendering possible a quickening of production and an increased capacity for the plant.

Ordinarily, the towers or scrubbers between the lead-chambers, by reason of their filling or packing, act merely to mix the gases thoroughly before they pass on into the next chamber, thus facilitating reaction therein.

In the present process and apparatus, however, the cold diluted acid introduced into the towers or scrubbers is used to precipitate the acid mist that forms, and such portions of the apparatus may be considered merely in the nature of scrubbers. The cooling in such parts of the appliance is incidentally beneficial but is not the main purpose for their use.

Glover and Gay Lussac Towers

The usual procedure of sulphuric acid manufacture is illustrated by reference to Fig. 1, which is a diagram of the side elevation of the plant, wherein the hot gases from the sulphur or pyrites burner 11 pass into the Glover tower 12 into the top of which at 13 is fed weak acid and at 14 nitrous vitriol from one (15) of the Gay Lussac towers 15 and 16. Acid drawn from the bottom of the Glover tower is reduced in temperature in the cooler 17 and fed into the top of the Gay Lussac tower 16 by means of connection 18. Nitre for replenishing is supplied by potting or any other approved method.

From the top portion of the Glover tower, the gases flow into the upper part of a preliminary distribution-chamber 19 from which they pass through a plurality of conduits or flues 21 located at different elevations to the first, elongated, rather narrow lead-chamber 22 of substantial size and capacity.

Heat Dissipation

The hot gases in the initial or manifold chamber 19 are subjected through the side and top walls to sprays of cooled diluted sulphuric acid obtained from the bottom of the same chamber where the withdrawn acid is diluted by water introduced at 23, the thus weakened acid being lowered in temperature by a cooler 24 supplied with cooling water in any approved manner, the cooled diluted acid being fed through pipe connections 25 to the several spray nozzles of the same chamber, as is illustrated.

The water of such weakened acid, when sprayed into the chamber, is consumed in the usual way in the further production of sulphuric acid, whereas the cooled acid of such diluted liquid acts merely or principally as a constantly traveling cooling medium traversing the chamber and the gases therein for conveying away a substantial proportion of the heat developed by the reaction, whereby the radiating capacity of the lead walls of the chamber are not relied upon solely for this purpose, their heat dissipating function being supplemented by the cooling action of the introduced acid of the sprays.

The heat thus taken up by the circulating acid is abstracted by the cooling water of the cooler 24, which in addition absorbs the heat occasioned by the introduction of the diluent water added to the withdrawn acid after its leaving the chamber.

Thus the lead walls of the chamber are relieved of the burden of disposing of such latter heat, which in the ordinary chamber process is developed in the chamber rather than outside of it.

Extension of Apparatus—Circulation of Acid

The apparatus includes also two, or any other desired number of lead-chambers, 26 and 27, the three main lead-chambers of the particular appliance shown being separated from one another by suitable, packed, intermediate scrubbers 28 and 29 connected to the opposite ends of the two adjacent chambers by appropriate manifolds 31, 32, 33 and 34.

In similar manner, the last chamber 27 is connected through a like manifold 35 and interposed scrubber 36 to the first Gay Lussac tower 15. The bottoms of all four chambers and the three associated intervening scrubbers are connected together by suitable types of conduits 37, 38, 39, and 41, whereby the acid produced may readily flow from one to the other, being drawn off as a commercial product at any appropriate point, as, for instance, from the first large chamber 22 at the point 42.

Chamber acid is withdrawn from chamber 22, admixed with water, fed at 43, and lowered in temperature by a cooler 44, through which cooling water flows in the customary way, such weakened acid of reduced temperature being led through pipe connections 45 to the several sprays at the top and side walls of the same chamber and to the top of the adjacent scrubber 28.

These sprays produce the same effect in this chamber that the corresponding ones did in the first distribution chamber, i. e., they supply the water for the reaction and assist in cooling the chamber and its contents. Owing to the lengthened narrow shape or form of the chamber and the disposition or arrangement of the sprays, it is assured that all portions of the gaseous mixture are subjected to the minute particles or globules of diluted acid.

The cooled, weakened acid is also delivered to the top of the scrubber and allowed to run down over its packing precipitating out the acid mist, whereby the gases are freed therefrom and consequently better fitted for the continuance of the process in the next chamber or Gay Lussac towers as the case may be.

Thus the gases in all the chambers are treated in like manner for the same purpose, each having its own cooler 44 and means 43 for the addition of water, the diluted cooled acid being also fed to the top of the next scrubber.

A fan 46 for drawing the gases through the apparatus is employed in the gas connection 47 between the last scrubber 36 and the first Gay Lussac tower 15. An appropriate pump 48 is inserted in the connection 49 between the top of the first Gay Lussac tower and the bottom of the second, from the top of which the waste gases escape through a discharge connection 51, other parts, not shown, for the circulation of the acid as described being provided where needed.

Addition of Water as Dilute Acid

As has been presented, it is preferable to feed the necessary water to the chambers as an ingredient or constituent of the dilute acid, because it permits the ready and economical abstraction of the heat caused by its union with the acid outside of the lead chamber, thus reducing the heat dissipating load on the lead walls of the latter. If preferred for any reason, the water can be fed to the chambers separately from the acid.

The amount of water employed for reducing or diluting the acid is readily ascertained by the Baumé reading of the product, just enough being used to maintain such reading at a predetermined figure, for example, 50°.

Amount of Cooled Acid Circulated

The amount of cooled acid recirculated through the chambers and associated or intervening scrubbers is from about 5-20 times the amount of acid produced in the system. By constantly cooling such acid and by developing the reaction heat, caused by the added water, outside of the chambers where it can be easily gotten rid of, the capacity of the plant as a whole can be largely increased over a corresponding plant not employing such cooling medium.

being near 150° F., its sprays being around 100-110° F.; whereas the similar mean temperature of the last chamber is about 120° F., its diluted cooled acid being around 90-100° F.

Economic Considerations

In the manufacture of sulphuric acid on a commercial scale, the first cost of the installation is relatively high, by reason of the size of the plant and the materials employed, necessitating a comparatively heavy overhead operating expense. Anything, therefore, which will substantially enlarge the capacity of existing plants or which will permit the erection of new plants of a given capacity at a materially lessened expense is of importance.

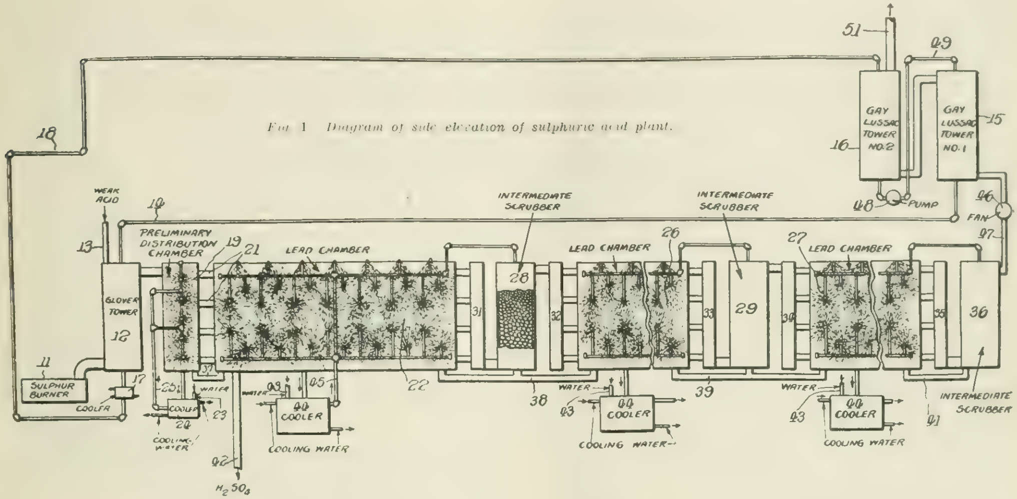


Fig. 1. Diagram of side elevation of sulphuric acid plant.

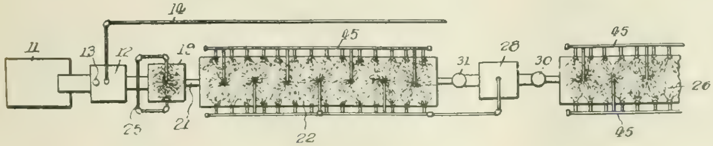


Fig. 2. Diagram of plan of sulphuric acid plant

Inasmuch as such reaction water is introduced into the undivided body of gaseous mixture at several sides or angles in an almost infinite number of extremely small globules or drops, the chemical transformation proceeds with abundant efficiency because all portions of the gas are adequately charged with such small particles of the water, thus facilitating and aiding the chemical reaction.

The cooling acid being likewise introduced into the gaseous body is particularly well fitted to perform its cooling function throughout the entire body of gas.

Density of Product—Temperature of Chambers

In the actual commercial practice of the process, the acid product is of approximately 50° Baumé, the average temperature in the initial distribution chamber being about 200-220° F., the cooled diluted acid of its sprays being in the neighborhood of 150-160° F.; the average temperature in the first large lead-chamber being about 170° F., the weakened acid of its sprays being approximately 120-130° F.; the corresponding temperature of the middle of the three large chambers

The improved system of cooling constituting the subject matter of my invention meets these requirements in that a plant fitted with this cooling arrangement will produce a greatly increased tonnage of the product, other complementary parts of the apparatus being operated in a coordinated manner to effect such increase in production; because the heretofore restricting capability of the chamber lead walls to dispose of the heat by radiation and convection to the outer air is henceforth of comparatively little moment as their work may be supplemented by the use of the cooling acid.

An advantage resides in using separate coolers for the several chambers, because, as their acids are of distinctly different temperatures, it is more economical and efficient, by reason of the greater possible range of permissible temperature in the cooling water of the coolers associated with the earlier chambers, to employ such a segregation, but, of course, a lesser number of cooling appliances may be used, or even one only may be employed, if preferred, and the temperature reducing acid may be drawn from all or any one or more of the several chambers.

Bauxite and Aluminum

Concentration of Low-Grade Bauxites. Expiration of Basic Patents and Hydro-Electric Development Promise Expansion in Aluminum Production

By T. Poole Maynard, Ph.D.
Geological and Industrial Engineer

BAUXITE, the chief raw material of aluminum, is a hydrated oxide of aluminum mixed always with varying impurities chiefly iron oxide, silica, clay, etc. Formerly imported from France, its production in the United States has increased from 129,000 long tons in 1909 to 521,308 long tons in 1920 and used in that year as follows: aluminum, 383,154 tons; chemical, 85,878 tons; abrasive, 52,276 tons, which includes a small quantity sold to manufacturers of refractories.

Domestic production of bauxite for 1921 is estimated by the U. S. Geological Survey at approximately 130,000 long tons, a decrease of 391,308 tons from the 1920 output.

This great decrease in the production of bauxite is largely the result of the curtailed demand for aluminum, particularly aluminum used in the automobile industry, though the curtailed consumption of chemicals containing alumina lessened the output of some of the mines, particularly in the Georgia-Alabama field.

The following concerns embrace the producers (who also are consumers) of bauxite in 1920:

American Bauxite Co., 1111 Harrison Building, Philadelphia, Pa.
E. I. du Pont de Nemours & Co., Wilmington, Del.
Globe Bauxite Co., Joliet, Ill.
Kalbfleisch Corporation, 31 Union Square West, New York, N. Y.
Mineral Products Corporation, 2234 Dime Savings Bank Building, Detroit, Mich.
Norton Co., Worcester, Mass.; Niagara Falls, N. Y.
Republic Mining & Manufacturing Co., 1111 Harrison Building, Philadelphia, Pa.
Warner Mining Co., Adairsville, Ga.

The following additional concerns comprise those known to the U. S. Geological Survey as users of bauxite:

Aluminum Co. of America, Pittsburgh, Pa.
Booth Chemical Co., P. O. Box 203, Elizabeth, N. J.
Carborundum Co., Niagara Falls, N. Y.
Charles Lennig & Co., Inc., 112 South Front Street, Philadelphia, Pa.
Charles Taylor Sons Co., Cincinnati, Ohio.
Columbus Waterworks, R. D. 5, Columbus, Ohio.
Como Chemical Co., Kokomo, Ind.
Cumberland Waterworks, R. D. 3, Cumberland, Md.
Detroit Chemical Works, 238 Junction Avenue, Detroit, Mich.
Detroit Waterworks, Detroit, Mich.
Eno Chemical Works, 31 Union Square West, New York, N. Y.
Exolon Co., 156 Sixth Street, Cambridge, Mass.
General Abrasives Co., Niagara Falls, N. Y.
General Chemical Co., 25 Broad Street, New York, N. Y.
General Refractories Co., 111 Broadway, New York, N. Y.
Gulf Refining Co., Pittsburgh, Pa.
Harbison-Walker Refractories Co., Pittsburgh, Pa.
International [illegible] Corporation, 5 Dorchester Avenue, So. Boston, Mass.
Jarecki Chemical Co., St. Bernard Station, Cincinnati, Ohio.
Kalbfleisch Corporation, Chattanooga, Tenn.
Laclede-Christy Clay Products Co., St. Louis, Mo.
Massillon Stone & Fire Brick Co., Massillon, Ohio.
Merrimac Chemical Co., 33 Broad Street, Boston, Mass.
Metropolitan Water District of Omaha, Omaha, Nebr.
Montclair Water Co., Paterson, N. J.
Pennsylvania Salt Manufacturing Co., Widener Building, Philadelphia, Pa.
Springfield Waterworks, Springfield, Mass.
Superior Chemical Co., Joliet, Ill.
Trenton Waterworks, Trenton, N. J.
Welch Chemical Co., 8 East Long Street, Columbus, Ohio.

The production of bauxite in France in 1920 was 186,653 tons. There has been a large increase in production and exportation of French bauxites during 1921. The low rate of exchange and the low ocean rates from France to points along the Atlantic seaboard have operated in favor of the development of French bauxites during the past year and a very large tonnage has replaced the American production.

The annual maximum production of half a million tons of bauxite, with every prospect of increase on the return of normal conditions in industry, because of the increasing use of its metal derivative, directs attention to the approaching exhaustion of high-grade bauxites considered commercial by the present methods of mining. The high degree of integration in the aluminum industry, represented by the Aluminum Co. of America, has been possible by its control through its subsidiaries, of the high-grade bauxite deposits on one hand and by patent monopoly on the other.

The perfection of processes for the concentration of the alumina content of low-grade bauxites is of great economic influence in the enhancement of the value of bauxite deposits heretofore not considered of commercial importance because of their alumina-content of 52 per cent. or less. Marketable bauxite must have a minimum content of 52 per cent. Al_2O_3.

Bauxite is graded according to composition and is sold on analysis which should show total silica, alumina, titanium oxide, iron oxide and water. For aluminum production low silica- and titanium-content is essential, but the iron may be fairly high; for chemical uses the iron present should not exceed 1½-2 percent. While abrasives may be made from bauxite low in silica and iron, bauxites containing proportions of silica and iron greater than are permissible for other uses, can be used for abrasives.

Distribution of Bauxite

Our commercial bauxite deposits are in central Arkansas, northeastern Alabama, northwestern Georgia, southern-central Tennessee, central-western Georgia and northeastern Tennessee, readily accessible to the hydroelectric power in prospect at Muscle Shoals. The Arkansas field yielded 92 percent of the bauxite produced in 1920.

Bauxites found in the Coastal Plain area are of very great promise. The low grade ores are now extensively used in the chemical industries. The deposits, particularly in the area traversed by the Central of Georgia Railway, will be found particularly desirable for the manufacture of refractories.

The companies mining in the Georgia field are: The Republic Mining & Mfg. Company; General Bauxite Company; Kalbfleisch Corp.; General Abrasives Company and several smaller operators.

The bauxite deposits of Alabama and Tennessee are similar in the nature of their occurrence and origin to the deposits of north Georgia. The Alabama deposits extend from the vicinity of Piedmont to Cave Springs, striking across the State in a general northeast direction. The deposits cross Georgia and are mined in the vicinity of Chattanooga and in Carter County, Tennessee.

Bauxites wherever found are intimately associated with clays. There are three major types of bauxites characteristic of the areas in which they are found, viz., the Arkansas deposits, the type found in the North Georgia-Alabama and Tennessee areas and the South Georgia deposits. There are also many variations of the type characteristic of these respective fields.

The engineer who for the first time observes bauxite mining in the Appalachian Valley field would be amazed to see clays and low-grade bauxites carted away in wheelbarrows, the ore mined by pick and shovel and raised from these funnel-shaped openings by skips and aerial cableways. Although the deposits are above water level, the large "V" shaped pits are usually drained by pumps and during rainy seasons these pits are "loblollys" and the cost of mining made prohibitive, due in part to the nature of the deposits and in part to natural human tendencies where there is a monopoly of anything.

It is evident from what has been said about the bauxite deposits that:—

1. The present methods of mining are wasteful. Many bauxite mines have been abandoned, it proving unprofitable to work many deposits of low-grade, or even win the high-grade ores on account of the large number of clay "horses," or the proportion of clay to bauxite being greater than could be worked profitably by hand methods.

2. That in any event only the mines most favorably located with relation to transportation and overburden, or deposits of high grade could be worked profitably on account of the high cost of mining.

3. Large deposits of low-grade bauxites of 45-50 percent alumina-content have not been considered of commercial interest.

4. Independent corporations have been kept out of the field on account of the practical impossibility of getting sufficient tonnage of bauxite to warrant commercial development other than on a very small scale.

5. The development of the industries dependent upon bauxite for their raw material has been retarded by the lack of confidence of capital that they could be assured a supply.

Everhart Process of Concentrating Low-Grade Bauxite

The alteration of clays into bauxite ordinarily has been so gradual that the slight distinction in the two materials imposes great difficulty in their separation in the process of concentration. In the study of many bauxitic clays, Dr. Edgar Everhart has demonstrated that this physical difference is sufficiently marked, however, to allow of satisfactory separation by washing in the presence of small amounts of added peptizers. This makes possible the recovery of bauxite from two types of deposits hitherto not considered of commercial interest, namely, first those deposits carrying both granular high-grade ore and mixed with varying grades of low-grade ore, where the proportion of clayey impurities varies from as low as 2 to 1 to where the proportion of clay to bauxite is as much as 7 to 1.

The result on this type of ore is as follows:—

Crude Ore		Concentrated Ore
48.87........	Alumina (Al_2O_3)	57.85 percent
24.39........	Silica (SiO_2)	11.60
2.94........	Iron Oxide (Fe_2O_3)	1.76
2.13........	Titanium Dioxide (TiO_2)	2.13

The second type of deposits made available are the so-called low-grade bauxites and bauxitic clays carrying from 45-52 percent alumina, which are not now considered of commercial value but which can be concentrated to from 55-58 percent alumina, with a loss of clayey impurities varying from 25-45 percent.

Bauxites from a wide range of localities have been tried out by this process. The most successful commercial peptizers used are sodium hydroxide and the more strongly absorbed sodium salts. Patents have been granted covering the use of the above materials and process. A curious phenomenon observed in connection with these experiments is that in a few of the highly aluminous clays sulphuric acid, which usually acts as a coagulant, appears in the role of a peptizer in certain low concentrations. Another feature of very great commercial importance is that the iron and titanium oxides contained in the clay substance are not precipitated with the alumina, but are washed out with the clayey impurities. This makes available for the chemical industries as well as for the manufacturer of aluminum an ore high in alumina and at the same time very low in iron and titanium.

The use of this process does not involve any particular type of macvhinery. It can be adapted to the wide variety of washing and concentrating machinery now on the market, dependent entirely on local conditions. As this process of concentrating bauxite is the converse of the present system of clay washing, the clays can very readily be recovered in the refined condition and used in suitable by-products. Extensive tests have shown that this means of concentration can be applied with success to a wide variety of low-grade bauxites in the three great fields in this country. While certain indurated and more silicious ores are not susceptible to treatment, there remains a broad field of application.

The use of these methods can make possible the use of mechanical equipment in mines, save much of the wasted overburden and make commercial many of the underlying bauxitic clays, thereby making available the immense deposits so low in alumina that they have never been opened.

Aluminum

The Aluminum Co. of America is the sole producer of aluminum in this country and turns out one-half of the world's consumption. Aluminum manufacture falls into two groups, viz., (1) plates, sheets and rods and wire and tube, and (2) manufactured articles or wares in which business 34 companies are engaged. Rapid as has been the growth in the use of aluminum, there would be much wider use if it were available at lower cost, a condition requiring competition in its production and impossible because of patent protection, control of large tonnage of high grade bauxite and a condition involving cheap hydro-electric power. Many of the manufacturing patents having expired it is felt that there is no longer this obstacle to the expansion of the industry.

Aluminum stands forth in use among the non-ferrous metals, being surpassed by copper, zinc and lead; the last two it bids fair soon to overtake. Richards hazards the thought that lead will be surpassed by 1930 and zinc by 1940 and says that in variety of uses and importance of its functions, aluminum is exceeded probably only by iron and copper.

The open-market price of primary aluminum during

1920 varied with little fluctuation between 32 and 34.85 cts. per lb., with a domestic consumption, as estimated by the U. S. Geological Survey, valued at $58,310,341. which includes imports valued at $13,077,022. These figures represent a production growth of the primary metal, which may be attributed largely to war requirements, from an output in 1916 valued at $41,375,000. The difference between the production and consumption values for 1920 is represented by imports and stocks of the secondary metal.

The primary intermediate product in the separation of aluminum from bauxite is alumina, the hydrated oxide, prepared by the fusion process described later for the manufacture of aluminum sulphate.

In the Bayer process the bauxite is first calcined, then finely ground, mixed with caustic soda solution of about 47° Bé, and heated for some hours with steam under a pressure of 5-6 atmospheres, which forms a solution of sodium aluminate. This is then diluted to 24° Bé and filtered rapidly. So prepared, the solution contains about 1 Al_2O_3 to 1.8 Na_2O. This is run into an autoclave, some precipitated alumina stirred in, and the solution agitated for three days, by which time about 70 per cent. of the alumina has separated and the solution contains 1 Al_2O_3 to 6 Na_2O. The aluminum hydroxide is then filter pressed and air dried. The solution is again heated with powdered bauxite until its composition corresponds to 1 Al_2O_3 to 1.8 Na_2O. and the process repeated. There are a number of modifications of the Bayer process.

The Serpek process, used primarily for the fixation of nitrogen, has been used to some extent. This method depends upon the formation of aluminum nitride, AlN, by heating bauxite in the presence of carbon and nitrogen at a temperature between 1,800° C. and 1,900° C. The mixture of bauxite and coal or coke is calcined in a kiln and then heated in another kiln to 1,800° C. to 1,900° C., where gas, produced by passing air through a gas producer, is forced through the heated mass. This forms aluminum nitride, which, when treated in an autoclave with steam under pressure, is decomposed into ammonia and aluminum hydroxide.

In the production of "pig" aluminum by the Hall process of reduction the alumina is electrolyzed in a bath of fused cryolite or mixed fluorides contained in a carbon-lined vessel the sides of which serve as the cathode, while carbon electrodes immersed in the bath serve as anodes. The alumina is added to the fused bath and undergoes decomposition by electrolysis, the oxygen collecting at the anodes and consuming them with the formation of carbon monoxide, while the metal collects at the bottom and is tapped off as required and moulded into pigs of about 45 pounds each.

The melting of pig aluminum, alloying it with copper and casting the alloy into ingots for rolling into sheets or for the production of the innumerable forms of aluminum castings is the function of the aluminum foundry of which there are a great many of various sizes.

Aluminum foil is replacing lead and tin foil because of the greater covering surface per pound of metal. The metal has displaced bronze as a basis of varnish powders. Tubing, the manufacture of extruded shapes, container [illegible], wire and cable are additional uses of the metal. Sheet and castings, however, constitute the chief uses as illustrated in the wares and automotive industries.

Chemical Uses

Production of aluminum salts in 1920 aggregated 250,000 short tons valued at near 10 million dollars, and embraces chiefly alums, mainly ammonium and sodium, aluminum sulphate and aluminum chloride. Eight plants in central and eastern United States produced in 1920 16,284 short tons of alum valued at $992,259. Three plants produced 3,571 tons of aluminum chloride valued at $297,550. Eighteen commercial plants in 1920 produced 229,888 tons of aluminum sulphate valued at $8,104,457. Six municipal waterworks plants produced 4,115 tons. Aluminum sulphate is used largely in paper making for the preparation of sizing material; as a mordant for dyeing; for the purification of water; for tanning skins; and for the refining of mineral oils. In general it is used for all purposes where crude alum was formerly used. It does not crystallize as well as alum and is therefore not so easily purified. Considerable quantities are used in making alums and other aluminum salts.

In its manufacture bauxite is ground, mixed with soda ash, and calcined at a white heat. The resulting mass is ground, lixivated with water, filtered, and treated with carbon dioxide. The precipitated hydrate of alumina is then added to hot concentrated sulphuric acid until frothing ceases, after which it is run into crystallizing pans.

Alum, the double sulphate of aluminum and of the metal, usually the alkali metals, or iron or chromium, which gives to the salt its characteristic name, is made from aluminum sulphate obtained as above described and then adding the exact amount of the alkali sulphate to form the desired alum.

Abrasives

The proportion of aluminous abrasives to silicon carbide abrasives in this country is about in the ratio of 8-10 to 1.

Bauxite abrasives, sold under various trade names, such as alundum, aloxite, exolon, and lionite, are made by fusing bauxite in an electric furnace. These products are sold in the form of powders, cloth, grinding stones and wheels of various shapes, and for a multitude of uses. Abrasive makers used 52,276 long tons of bauxite in 1920.

Summary

Constituting, as it does, the most abundant metallic element, aluminum has a future limited only by its price, which in turn is determined by ease of the recovery of its ores from the earth and the efficiency of processes to separate it from its compounds. The natural commercial compound or ore is the mineral bauxite. With the perfection of processes for the concentration of the alumina-content of low-grade bauxites, an almost unlimited tonnage of concentrates high in alumina and low in silica is made available, whereby will be eliminated the most powerful integrative force in the industry and competition encouraged.

I represent 200 independent dye manufacturing concerns in my state. I am not particularly interested in the question of whether there is a dye monopoly or not; I am more interested in the attacks which have been made upon an American industry which was built up during the war and which, unless there is appropriate legislation, and if this antagonism continue, will be severely injured. In my own state the dye companies are anxious to do business; they are restive over this situation. The textile industry throughout the country is interested. These men, the representatives of the American dye companies, are here with these charges resting over their heads; and all we ask is that the testimony be taken.—*Senator Frelinghuysen (N. J.) to the Senate dye probe committee.*

Comment on "Cogitations on the Chemist"

By L. R. Seidell
Managing Director, New York Testing Laboratories

IN the article "Cogitations on the Chemist," CHEMICAL AGE, January, 1922, Dr. Jordan's discussion of the present status of the chemist and his future prospects bears on a matter which at present appears to be a subject of discussion among the leaders of the profession.

Dr. Jordan's questions which follow, certainly offer food for discussion, to wit: (1) Why should over 90 per cent. of the chemists turned out from college look forward to "getting a job," and, (2) why is chemistry not practised as a profession, just as a lawyer or a doctor practises his profession. As a graduate chemist who has held his job and is now practising chemistry as a profession. I have formed some very decided opinions along the lines of these questions which may be of some interest to the profession in general.

Industrial Discipline Indispensable

As to "getting a job," how many of the courses in chemistry among the different colleges are fitting their men for any other purpose? Some colleges take pride in the fact that each year every man graduated has been provided with a job. I firmly believe that the young chemist needs this job if he is to be of the greatest value to his profession.

As it happens, the February 1st number of *Chemical & Metallurgical Engineering* contains an editorial on "Developing Chemists in the Industries." Here the young chemist "gets his job," perhaps the first job coming along which offers an income. To the industries this chemist should be looked upon as raw material for other departments. To the young chemist this prospect is held out: "climbing through from the first step in industry as a laboratory man, up to the second as a 'straw boss,' and on to the third as a department foreman, the chemist of industry is standing where he may look over the nearer landscape and get a glimpse of the peaks of executive control beyond."

The Purpose of Chemical Education

The newly fledged physician or lawyer undergoes a preliminary training in the hospitals or courts for the sole purpose of eventually practising medicine or law, as a *profession*. Now why, in the name of Heaven, can we hold out to the young chemist only the dazzling prospect of advancing from the laboratory to be a "straw boss" and perhaps eventually the president of the concern? I agree that such is the present condition. But is this not a confession that in the field of industrial chemistry there are no heights that the future holds out to the ambitious young chemist as a sufficient inducement to keep him in the profession?

Are we training our men to be chemists, or to be executives? To be frank with ourselves, as applied to industry, is chemistry a profession, or merely a stepping-stone job into the executive end of the business? The evils against which we have to contend in the profession are practically the same as those confronting the chemist on the job.

It is my firm conviction that no one is responsible for these conditions but the chemist himself and it is only the chemist who can remedy them.

The paragraph which ends "Do not hide your light under a bushel" should be expanded into a book, because it undoubtedly covers a multitude of the chemist's shortcomings. I have noticed that whenever his own ability is contrasted in any way with another's, the chemist has a large hammer in one hand for his rival and the trumpet of praise in the other for himself. But to what extent has he the ability to prove the worth of his profession in terms of dollars and cents to his superiors, and incidentally his own worth? Only by elevating the status and value of his profession in general, can the status of the individual chemist be raised.

It is common practise for physicians to call on several of their colleagues for consultation in difficult cases; the same applies to law, but have you ever heard of this condition arising openly in the chemical profession? In the profession of chemistry, the chemist sells his knowledge or services to industry for a price. I have found that the most difficult man to sell (discussing price only) is the chemist on the job. I have been forced finally to conclude that the majority of chemists do not even know what is the actual cost of their most routine determination, while the cost delivered to an outside concern (enter our old friend Overhead) is utterly beside the question.

Production Costs of Chemical Service

If the chemist does not know the cost of his work he can place no definite value on it, and what the chemist himself cannot value, you certainly cannot expect his superiors to value for him. They are far too apt to look on his work as necessary, perhaps, but of no great consequence — a few figures on a report sheet, not realizing that it may have taken several days or a week of work to obtain these figures.

Along this line, I would like to cite an experience of my own. At one time I was in charge of a laboratory for an industry which bought a number of parts outside. One of the executives told me that he had promised an outside concern to handle their chemical and physical testing for them gratis and ordered me to handle this as our own. This charity work, as we called it, soon ran into hundreds of dollars in service, and its value was not even appreciated by the concern for which we did the work.

The point I wish to make is the fact that this service was given away with no thought as to its value and accepted in the same spirit, whereas, if this executive had been giving away material, even defective parts, he probably would have been arrested for larceny. I know there are some concerns with laboratories whose executives give away chemical service to their customers to hold their good-will.

This impression as to the lack of value of chemical work pursues us into the professional or consulting field, and, as I will attempt to show, is fostered by the ones who should be our best friends. You can readily see that the condition given above diverts from its regular channel what is undoubtedly a very large volume of work during the course of the year. It really constitutes unfair competition, of which condition I will give several more examples.

Institutional Competition

In a professional way, we find that we are often compelled to compete for our work with educational institutions and with the very men who have trained us in our profession and have sent us out into the world to make, presumably, a living in that profession. Time and again, when submitting a price for a certain class of work, I have encountered the statement that the price was much too high; that this college or that professor would handle the work at a price which was utterly out of the question for us to meet. I have lost contracts for extensive tests and examinations, etc., because some professor with a class of students would undertake the work for expenses on account of the experience which the students would get out of it.

If a fair market price were asked for these services no objection could be raised, but it is most decidedly unfair competition to be compelled to encounter work furnished at prices which need not take into account the usual overhead expenses of any business concern, work which perhaps is even handled by students at no expense whatever to the man selling the service.

Questionable Competition

Just a few more forms of not serious but merely annoying competition:

I. A very large concern which has practically a monopoly on its product has issued literature stating that they were selling the services of their very well equipped laboratories to the industries in general. Are they going to sell laboratry service, or will they use their laboratory as a means of selling their main product?

II. A reputable chemical magazine carried the blind advertisement of a man who stated he could handle a certain line of analyses at a low figure. No name given. I suspect that this chemist intended using the equipment of his employer without his knowledge.

III. A large engineering concern maintains its own laboratory. Several times I have run up against very low bids from it for certain classes of work and have learned that since it requires a laboratory for its own purposes, it is willing to take on outside work, even at a loss, in order to help pay the expense of its laboratory.

While these conditions are perhaps annoying to us at times, I want to state that I am not breaking a lance against them for personal reasons. The most serious point is the effect which they have on the status of the chemist in general and on chemistry as a profession. Something is wrong with chemistry as a profession, and what are we going to do to right it?

Some Mistakes in Recommendations Under the National Workmen's Compensation Schedule

By Charles E. Sholes

Under the title of "Storing and Handling of Inflammable Liquids and Acids" and against No. 231 of this printed instruction sheet, it is stated:

> "We would suggest that the matter of handling acids by one of the three following methods be given serious consideration. Gravity systems, compressed air systems, power pumps."

Of course, this is only a mistake or omission in expression, but it has perhaps led to some very dangerous misuses of compressed air, i. e., for emptying carboys and drums that are not designed or intended to withstand air pressures.

Every chemist and acid maker would know that the suggestion is only intended to apply to very large volumes of sulphuric acid and mixed acid used for nitration. But the "man in the shop" is not always able to make such distinctions, and there is no question but that the schedule should particularize the acids to which it refers.

While some muriatic acid is shipped in tank cars, it is usually syphoned into carboys at destination. Nitric acid is always and only shipped in and stored in carboys, and acetic acid is always shipped in barrels or carboys.

The schedules mentioned are in use in practically all the States, and should not only be corrected because of the mistake above mentioned, but because they are also out of date in other particulars. They only specify certain devices for emptying the carboys and overlook those equipments with which the user of acids can now handle acids in carboy containers just as safely, expeditiously and economically as the acid-maker does it.

An analysis of accidents by which one or more persons are burned or otherwise injured while handling acids shows that they are due to (a) Mistakes of method (pouring water into sulphuric acid instead of acid into water, etc. (b) Bad containers. (c) Air pressure used on carboys or drums, (d) Unnecessary slopping or spattering, (e) Material left in containers supposed to be empty. Also, accidents are perhaps more often due to fault or lack in tools than to workmen.

During the war, and until very recently, the I. C. C. specification required that "empty" carboys returned should be stoppered. But it was found that the stoppered empty carboys often contained acid, and that the rule did not prevent accidents. So it is now only decreed that carboys must positively be empty when delivered empty to any railroad for transportation.

The average carboy is stored out of doors or in damp places, and is also subject to so many sloppages that notwithstanding all the care with which acid-makers inspect, wash and repair each package, the boxboards will rot and nails will be eaten therefrom, so that the bottom drops out and inclinator hooks slip. Also, crockery pitchers will crack and drop off handles, and the supposedly empty carboys are turned over and spill acid which could not be conveniently drawn off when the carboy was in the inclinator, etc.

Most of these accidents could be avoided by the use of carboy trucks, with which one man can handle carboys about factory and yard without touching them; carboy carriers with which two more men can completely empty carboys into vats, etc., while well away from the splashing liquid; carboy dumpers, which safeguard against bottom dropping out and enable one man to safely and accurately draw small quantities without touching the carboy and until it is completely empty; Monel metal pails and dippers, which will not break and which will withstand sulphuric acid, acetic acid, caustic potash and soda bleach, and most solutions of sulphates, sulphides, sulphites, acetates, etc.; rubber buckets, pitchers and dippers, which withstand muriatic acid and most solutions of chlorates and chlorides; copper pails and dippers, for acetic acid, dyes, etc.; and cast aluminum pails, pitchers and dippers for nitric acid and solutions of nitrates, nitrites, etc., and which will not only safeguard the workmen, but will in some cases accomplish important and immediate savings, and are always more economical in the long run.

The Southern Dyestuffs Co., Nitro, W. Va., has begun the manufacture of beta-napthol in one of six installations it has under construction in former munitions buildings at Nitro. The plans contemplate the production of 100 standard intermediates when the entire plant is finished and about 200 men will be given employment.

Industrial Gases and Their Containers

The Compressed Gas Cylinder and a Method for Testing It

By Edward O. Benjamin
Engineering Chemist

INDUSTRIAL gases have become an important commodity in manufacture and commerce. Their importance as an instrument of warfare was demonstrated in the World War. The general method of distribution of gases involves their compression into steel cylinders, and their shipment in these readily handled containers. In some instances the gases, upon being compressed, simultaneously become liquefied and remain in a liquefied state while confined within the cylinder.

As an example of the extent of the industrial gas industry, it may be said that there are over 5,000,000 gas cylinders in service in North America in the transport of the manufactured gases described in this article. In the description of each gas emphasis is made of the importance of their respective utility, the number of manufacturing plants producing the several gases and the number of cylinders used in each case. .

Acetylene

Acetylene (C_2H_2) is used for welding and cutting of alloys of iron and similar metals, for the removal of wreckage, building tanks, boilers and even steel ships. It is extensively used for illumination, both portable, as in the case of the automobile, marine buoys and lighthouses, as well as for illumination and fuel in isolated buildings. There are 16 commercial manufacturers filling cylinders with acetylene at 65 filling plants scattered throughout the country. There is an enormous number of isolated generating plants which are not considered here as having any connection with cylinders, as the gas is piped directly from the generator to the point of use. In this industry no less than 2,500,000 cylinders are in service. These cylinders are made and tested under Specifications No. 8 of the Interstate Commerce Commission.

Ammonia

Ammonia, Anhydrous, (NH_3) is used chiefly in the refrigerating industry, both in cold storage as well as in the manufacture of artificial ice. It has found a limited use in the manufacture of chemicals, including dyes and explosives. There are 13 commercial manufacturers filling about 200,000 cylinders with ammonia, at 16 filling plants. The gas is obtained as a by-product in the manufacture of illuminating gas and coke, and is produced synthetically by the Haber process, which directly combines hydrogen with nitrogen, by the cyanamid process and by the Serpek process. In this industry there are various types of cylinders used. They are made and tested under I. C. C. Specifications No. 4.

Argon

Argon (A) is used chiefly in the filling of incandescent lamp bulbs, rectifiers for converting limited alternating current to direct current, and in the filling of audions for wireless work. There are 7 commercial manufacturers, filling about 1,000 cylinders with argon, at about 7 filling plants. The reason for the large number of filling plants in proportion to the comparatively limited amount of argon used is the fact that argon at present is obtained entirely as a by-product in the liquefaction of air and its fractional distillation. Therefore, every plant producing oxygen or nitrogen from the air is in a position to produce argon as a by-product, as on the average 1% of the atmosphere by volume is argon. These cylinders are tested under I. C. C. Specifications No. 3-a.

Carbon Dioxide

Carbon dioxide (CO_2) is used chiefly in carbonating beverages, as soda waters, fruit juices, etc. Its minor uses are in refrigerating machinery, the chemical industries, displacement of oxygen in the destruction of vermin, and fire extinguishing, and in therapeutic treatments. There are 24 commercial manufacturers, filling about 500,000 cylinders at 55 filling plants. These cylinders are tested under I. C. C. Specifications No. 3.

Chlorine

Chlorine (Cl_2) is the most extensively used commercial gas in the chemical and allied fields, and in chemical application in the industries, as in the bleaching of textiles, straw products, sponges, chlorination of ores in metallurgical processes, manufacture of bleaching powder, picric acid, and an essential raw material of poison gases. Its active characteristics as a germicide and insecticide render it particularly suitable for the sterilization of drinking water, purification of sewage, as well as the protection of grain from the destruction of rodents and insects. Its chemical activity makes it a very valuable agent in the chemical laboratory, de-tinning, the production of tetrachloride of tin used in the weighing of silk, zinc chloride for the impregnating and preserving of wood as well as in the manufacture of vulcanized fibre, the manufacture of carbon tetrachloride used for fat extraction, in the rubber industry, dry cleaning, as well as in fire extinguishers. In the pharmaceutical field chlorine is used to make chloroform, aspirin, and a great many other products. In organic chemistry chlorine is used in the manufacture of synthetic indigo, sulphur colors, benzoic acid, etc. There are 8 commercial manufacturers filling about 30,000 cylinders at 12 filling plants. These containers are made and tested under I. C. C. Specifications No. 25-27.

Helium

Helium (He) is used chiefly in the lamp industry, both for filling of incandescent lamps as well as in the McFarland-Moore type of lamps. Considerable interest has been aroused recently in its use in aeronautics as a substitute for hydrogen, helium being non-combustible. At the present time a large number of cylinders are used for storing helium gas obtained from certain gas wells in some of the oil fields of Kansas and Texas. Obtaining of helium from air is impractical as only one volume of helium can be obtained from 250,000 volumes of air. There are about 80,000 cylinders in this service. There are three filling stations and four experimental stations in North America, but very little work is done at present towards saving the large volumes of helium that escape with natural gas at the various wells. The cylinders used fall under I. C. C. Specifications No. 3-a.

Hydrocyanic Acid

Hydrocyanic Acid (HCN), sometimes referred to as Prussic Acid, Hydrogen Cyanide, Formonitrile, is used chiefly as an insecticide, particularly in California and Florida. It had limited use as a poison gas in the war, and seems to present possibilities in the chemical industries, as well as in metallurgical processes in conjunction with electrolytic recovery of some of the noble metals. There are 3 manufacturers of this gas filling a limited number of cylinders at 3 stations, which are governed by I. C. C. Specifications No. 33. A large amount of this liquefied gas is transported in tank trailers and hauled by automobiles, thereby avoiding railroad transportation.

Hydrogen

Hydrogen (H_2) is used chiefly in the hydrogenation of oils, production of synthetic ammonia in conjunction with nitrogen, filling balloons, cutting of metals in conjunction with oxygen, reduction of metals, a fuel in the manipulation of glass, the production of synthetic sapphires and other gems, fusing of silica, platinum, lead-burning, etc., treating of wool, annealing of steel and as a heating agent in conjunction with oxygen for lime lights. There are 58 commercial manufacturers of hydrogen filling about 200,000 cylinders at 86 filling stations scattered throughout the country. In addition to these there are a large number of industrial plants which manufacture hydrogen for their own use, and do a limited amount of filling or shipping, bringing the total number of hydrogen generating stations to 195, involving the use of no less than 10,000 additional cylinders. These cylinders are made and tested under I. C. C. Specifications No. 3-a.

Methyl Chloride

Methyl chloride (Chloromethane) (CH_3Cl) is used chiefly as a refrigerant in the household, small restaurant and industrial refrigerating installations. It also is used as a general anaesthetic, having properties resembling that of nitrous oxide; as a local anaesthetic in skin operations; as an extracting agent for volatile essential oils and perfumes; as a liquid for filling low-temperature vapor tension thermometers. For the last-named purpose this product has proved very satisfactory in equipping airplane radiator thermometers. There is one commercial manufacturer, filling less than 1,000 cylinders at one plant. The cylinders are made and tested under I. C. C. Specifications No. 25-27.

Neon

Neon (Ne) has been used to a limited extent for filling incandescent lamp bulbs and tubes for lighting, as in the McFarland-Moore lights; but recently a new use has developed in the filling of short tubes and placing a terminal in these as a fault-finder for the automobilist in determining the condition of his ignition system, taking advantage of the ease with which electric current passes through the gas, and thereby producing a bright red glow. As is the case with argon, this gas is obtained as a by-product of the fractional distillation of liquefied air, and at present a very limited number of cylinders is used for this gas. They are made and tested under I. C. C. Specifications No. 3-a.

Nitrogen

Nitrogen (N_2) is used from cylinders chiefly by the lamp makers in filling incandescent lamp bulbs. Due to its abundance in the atmosphere as well as the ease with which the oxygen can be removed from the air comparatively little nitrogen is distributed in cylinders. Although there are seven companies owning 61 plants capable of supplying nitrogen, very few cylinders are actively employed for this gas. However its use is unlimited in the chemical industry, as it plays a very important part in the production of synthetic ammonia, nitric acid, fertilizers, dyes and explosives, and indirectly in the production of cyanides, nitrides, and nitrates; also in the treatment of cellulose and organic compounds. Cylinders for compressed nitrogen are made and tested under I. C. C. Specifications No. 3-a.

Nitrous Oxide

Nitrous oxide (N_2O) is sometimes referred to as nitrogen monoxide or laughing gas, its main use being as an anaesthetic, used extensively in dental surgery and to a limited extent in other surgical operations. At the present time there are 10 commercial manufacturers, filling about 50,000 cylinders in 17 filling plants throughout the country. The cylinders are made and tested under I. C. C. Specifications No. 3.

Oxygen

Oxygen (O_2) is used in conjunction with fuel gases in the welding and cutting of metals, enriching air for blast furnaces, for breathing apparatus helpful in cases of pulmonary diseases, prolonging life, mine rescue apparatus, self-contained diving apparatus and gas helmets and masks, as well as gases in conjunction with anaesthesia, such as nitrous oxide, ethyl chloride and ether. It is used in the oxidation of oils; the preparation of ozone for disinfection, bleaching, sterilization of water and air, and for the synthetic production of vanillin and artificial camphor. The use of oxygen in the laboratory is unlimited for carbon determinations by the combustion method and as a rapid oxidizing agent where high temperatures are wanted, and in metallurgical operations. There are at present 67 commercial companies, filling cylinders with oxygen, at 149 plants throughout North America, and in addition to this there are 93 companies, operating 124 industrial plants. All told, there are about 1,500,000 cylinders used for the distribution of oxygen. The cylinders are made and tested under I. C. C. Specifications No. 3-a.

Sulphur Dioxide

Sulphur dioxide (SO_2) is used extensively as a bleaching agent in wood pulp paper mills, straw, sugar refineries and dye works, for fire extinguishers and as a disinfectant and as a refrigerant. There are 5 manufacturers producing sulphur dioxide and filling cylinders in the 5 plants, filling all told about 10,000 cylinders with the liquefied gas. These cylinders are controlled by I. C. C. Specifications Nos. 25-27-38.

Fuel Gases

In addition to the above-mentioned gases, there is a large number of fuel gases, consisting of hydrocarbon gases or vapors, some of which also contain carbon monoxide. These gases are sold under various trade names, such as Blaugas, Butane, Calorine, Carbo-Hydrogen, Coal Gas, Gasol, Kutting Gas, Petroleum Gas, Pintsch Gas, Pyrogen, Thermoline and others. Most of these are mixtures of various hydrocarbons such as methane or marsh gas (CH_4), ethane (C_2H_6) and in some instances propane (C_3H_8), propylene (C_3H_6), olefiant gas or ethylene (C_2H_4), benzine vapors, particularly light fractions obtained in the distillation of petroleum. These gases are generally obtained by the destructive distillation of coal, wood, oil or other carbonaceous material. Some are producer gas, water gas, casinghead gas; some, again, are by-products of chemical industries.

There are no less than 17 manufacturers who maintain 38 filling plants throughout the country, these gases being used chiefly for cutting metals, fuel and illumination, and to a very limited extent directly for chemical combination. However, the number of cylinders involved is quite large, being due to the fact that many of these are used in isolated sections, where transportation facilities are limited. Cylinders used for these gases are tested under I. C. C. Specifications No. 3 when the gases are liquefied and their charging pressure at 70° exceed 300 lbs.; under Specification No. 3-a when the gases are not liquefied; under Specifications No. 7 when the gas is not liquefied nor in solution, and the charging pressure does not exceed 300 pounds per square inch; and under Specifications No. 26 for liquefied petroleum gas, charging pressure not to exceed 1,000 pounds at 70° F.

Testing the Gas Cylinder

From this brief description of industrial gases it is obvious that they are sufficiently important to require special regulations in handling and shipping. For this reason the manufacturers of these gases, as well as the manufacturers of cylinders and valves are continuously co-operating with the Bureau of Explosives and other authorities to render their handling as safe as possible. Accordingly, special tests are prescribed by the Bureau of Explosives to determine the safety of the cylinder. A number of problems enter into these tests. They are based mainly on subjecting the cylinder to an internal strain not in excess of the theoretical elastic limits of the material. The methods to date permitted by the Interstate Commerce Commission, in their "Specifications for Shipping Containers," are:

(1) water-jacket method; (2) Sturcke - Watson-Stillman method; and the (3) simplified method.

In the first two methods the tests are purely visual; in the third, the test merely records the pressure applied and a drop in such pressure when the cylinder is allowed to rest.

New Method of Testing

A new method has been developed which takes certain details from the first and from the last-named method, and in addition combines an autographic feature, so as to eliminate the personal element, whereby great accuracy, uniformity in result, autographic record of the cylinder's characteristics and, above all, simplicity of operation, are obtained.

The operation may be outlined briefly as follows: The cylinder is placed within a jacket vessel, indicated by 11 in Fig. 1, provided with tight cover, 19, and inlet valve, 10, a means being provided to subject the cylinder to a hydrostatic test pressure in a given period of time. When the test pressure is reached hydraulic inlet valve, 2, is shut. The cylinder is allowed to remain under this pressure for a given period whereby the internal pressure on the cylinder is released in a fixed period. Throughout this performance a simultaneous autographic record is made on a chart placed on drum 8, by means of a specially-designed recording apparatus, whereby is drawn a curve whose locus is a function of the ratio of the internal pressure within the cylinder to the simultaneous total volumetric expansion of the cylinder under the given strain at the given time.

Advantage is taken of the well-known characteristics of metals when subjected to strains, viz., the reluctance to respond to external strains at the time of their application, which may be interpreted as a lag in the metal and upon the release of the stresses a corresponding lag in resuming the original form.

When the hydraulic pressure is applied to the cylinder, the Bourdon Tube, 7, will first respond, causing the drum, 8, to rotate. Following upon this, a distortion of the cylinder walls will cause a displacement of water within the jacket, thereby showing expansion, causing the pen, 16, to move in a vertical direction. These two motions will cause the point of the pen to describe a curve upon a blank chart placed upon the drum, this curve being the ratio of the expansion to the pressure and, correspondingly, the expansion would correspond to the plotting as the abscissae, and the pressure to the plotting as the ordinate of the curve.

In addition to this, the line described is dotted or intermittent, so as to overcome friction and to indicate the time elements involved. In this way, a contact is made between the pen and the paper for a period of 2½ seconds, and the pen is raised from the paper for a period of 2½ seconds. The device is so operated as to apply the total test pressure within one minute, shutting off the hydraulic presure for a period of one minute and permitting a release of pressure within one minute, making the total time of actual test within three minutes.

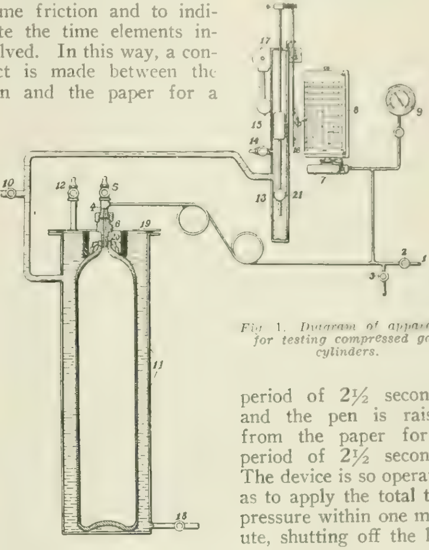


Fig. 1. *Diagram of apparatus for testing compressed gas cylinders.*

The apparatus lends itself to careful checking as to leaks or defects. Curve shown in Fig. 2 represents a test to determine a leakage in the low pressure water system. Portion of the curve a to b describes the admission of water into the system; b to c is caused by the shifting of the chart; while c to d would describe the amount of leakage in a given time.

Fig. 3 represents the chart of a test of the hydraulic pressure system; a leakage in this system would be noticed by the portion of the curve c-d.

The characteristics of a cylinder are shown by the chart of its test. The curve, Fig. 4, shows a heavy-walled cylinder, the strain being well within the elastic limits. There is practically no permanent expansion, indicated at the bottom left corner between the beginning and end of the total curve.

The greater curvature indicates the reluctance of the metal, the expansion taking place considerably after the force is applied; and on the reduction of pressure the recession of volume of expansion takes place considerably after the reduction of the pressure. This is clearly shown by a heavy-walled cylinder made of a soft, ductile material, in curve shown in Fig. 5. Being ductile, there is a large permanent expansion, a considerable amount of expansion taking place while the cylinder is left at a high pressure, bringing the total expansion somewhat high; and upon reduction of pressure the ratio of the permanent expansion to the total expansion will be found to be in excess of the safe

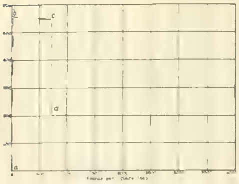


Fig. 2. Chart of test of the low-pressure water system.

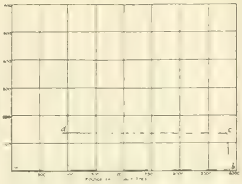


Fig. 3. Chart of test of hydraulic pressure system.

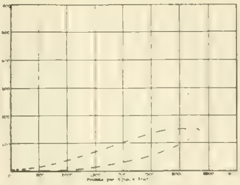


Fig. 4. Chart of test of a heavy-walled cylinder.

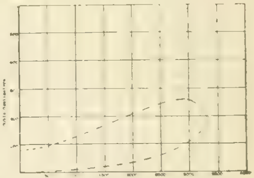


Fig. 5. Chart of test of a heavy-walled cylinder of soft, ductile metal.

limit. It is evident that this cylinder undergoes repeated expansion every time it would be subjected to high pressures, which eventually would increase the capacity of the cylinder, as well as weaken some portion of the walls, rendering use of the cylinder hazardous.

A thin-walled cylinder, however, may be elastic and sufficiently strong. Such a cylinder would produce a curve as in Fig. 6, showing that the expansion responds very nearly simultaneously with the internal pressure applied, bringing the curve to what would approach a straight line. When the test pressure is reached, there is no appreciable recession upon rest, caused by the further expansion of the cylinder, it having fully responded to the internal pressures; upon recession it would come back to very nearly the same starting point, showing little or no permanent expansion. A cylinder of this sort would be safe, and the curve would indicate that the elastic limit has not been exceeded.

A similarly thin-walled cylinder made of a soft, ductile material would show a recession of pressure at a point of rest, with accompanying expansion in volume, and upon reduction of pressure, the recession in volume would not be proportional, and would show a permanent expansion, as indicated in Fig. 7. This cylinder would not be safe, being subject to the same criticism that the cylinder indicated by Fig. 5 would be.

If a cylinder to be tested has a dent which flattened out during the period of test, a curve corresponding to Fig. 8 would be produced. This chart shows the break in the curve at point marked "d," indicating that at about 2,000 lbs. internal pressure the dent begins to flatten out and reaches a definite flattening out at 2,300 lbs. From then on the cylinder is nearly normal, showing a reasonable expansion upon rest and upon release of internal pressure a permanent expansion which, however, would be considerably in excess of the safe allowance, due to the fact that this permanent expansion is only apparent but not accurate, due to the additional expansion brought about by the rounding out of the dent in the cylinder. This cylinder should be subject to a re-test.

If a cylinder is tested and a considerable amount of expansion is shown with a comparatively little pressure, and a curve corresponding to Fig. 9 is produced, it would indicate that there is a leak somewhere in the cylinder, creating an unusually large apparent permanent expansion, being in fact the leakage of the water used in the hydraulic system through a portion of the cylinder, and entering into the water jacket.

In this method of test it is not very important to remove every trace of air from the interior of the cylinder, as it is in the simplified method. In the process of testing if every chart, as it is removed, is inscribed with the cylinder number, date, and other matters of importance, as well as the correct reading of the ratio of permanent expansion to total expansion, acceptance or rejection, ownership, identification of individual performing test, etc., it makes each chart a complete record and history of the cylinder, as well as a clear indication of its physical characteristics.

It may be noted that the volumetric expansion is a result of the strain in the cylinder, which is stressed by the force of hydraulic pressure applied, the stress varying with the hydraulic pressure, and the volumetric expansion varying with the strain. In this manner, when the apparatus has come to a rest at any period, an equilibrium is reached. The ratio described by these points of equilibrium are the equivalent of the coefficient of elasticity of the material multiplied by a constant varying with the dimension and form of the particular cylinder. If, during the test, the elastic limit of the cylinder is exceeded, expansion will continue till equilibrium is reached, and upon release of hydraulic pressure or the removal of stress, a permanent expansion will be shown by an increase of volume, which is referred to as the permanent expansion.

From this it will be seen that a person with elementary knowledge of mechanics and hydraulics, can understand readily not only the manipulation but the principle of this test as every step can be reasoned readily, and the steps, as well as results, are logical.

This method of test will assure, aside from the safeguards incident to the use of compressed gas cylinders, a greater safety due to the fact that a good deal will be known of the mechanical characteristics of the cylinder which to date has been unknown. It is believed that the broader knowledge of the public, of manufacturers, and particularly of chemists, of the convenience and possibilities of industrial gases as chemical raw materials and reagents, will promote the development of the compressed gas industry, which is now in its infancy.

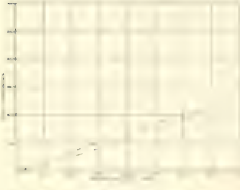


Fig. 6. Chart of test of a thin-walled cylinder.

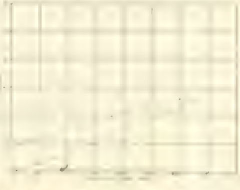


Fig. 7. Chart of test of thin-walled cylinder of soft, ductile metal.

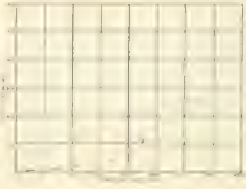


Fig. 8. Chart of test of dented cylinder.

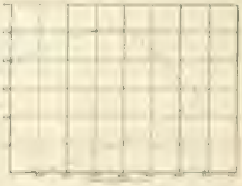


Fig. 9. Chart of test of a cylinder indicating a leak.

Personal Items

W. M. Bittle, formerly of the Duratex Co., Newark, N. J., is now production manager, U. S. Gauge Co., Sellersville, Pa.

* * *

Robert W. Hilton, formerly vice-president, Ault & Wiborg Co., Cincinnati, Ohio, will engage in consulting chemical practice in Cincinnati.

* * *

Dr. Lester A. Pratt, who has been in charge of the research laboratory of the Merrimac Chemical Co., Boston, Mass., for the past six years, has been appointed director of research.

* * *

Col. James Milliken has been elected president of the Pittsburgh Testing Laboratory, Pittsburgh, succeeding George H. Clapp, who remains with the organization as a member of the board of directors.

* * *

C. M. Willoughby, formerly chief of the sales promotion section, surplus war materials, Washington, D. C., is now connected with the American Relief Administration and is en route to Russia.

* * *

Dr. August Pacini, Washington, D. C., was awarded the prize of $1,000 for research work in roentgen-ray experimentation by the American Roentgen Ray Society at its recent meeting in Washington.

* * *

Robert Steineman, formerly of the National Aniline and Chemical Co., Inc., has been elected vice-president and general manager of The Tidewater Corp., 8 W. Fortieth Street, New York, pulverizers of iron.

* * *

Dr. J. Robert Smith is now associated as vice-president in charge of heavy chemicals, mineral fillers and dry colors, with his brother Casper Smith, president, Smith Chemical and Color Co., Inc., 257 Water Street, New York.

* * *

Fred P. Baker, formerly assistant director Boston station of the School of Chemical Engineering Practice of the Massachusetts Institute of Technology, is now a chemical engineer at the Ivorydale, Ohio, plant of the Procter & Gamble Co.

* * *

R. D. Leitch, formerly secretary-treasurer, Allulo Co., Sandusky, Ohio, is now junior gas engineer at the Central District Experiment Station, U. S. Bureau of Mines, Urbana, Ill., engaged in experimental work on iron oxides for gas purification.

* * *

Frederick C. Atkinson, chief chemist, American Hominy Co., and Dr. Frank R. Eldred, director scientific division, Eli Libby & Co., have resigned from these Indianapolis concerns to engage in independent practice as Eldred & Atkinson, Indianapolis, Ind.

* * *

Andrew H. Green, Jr., for many years head of Solvay Process Co.'s plant at Detroit, and of late vice-president, with headquarters in Syracuse, has been elected president of Charcoal Iron Co. of America, and will assume his new duties March 1.

* * *

Dr. Norman Bridge, treasurer of the Mexican Petroleum Co., and a resident of Los Angeles, Cal., has erected and equipped at a cost of $250,000 a laboratory of physics building, which he has presented to the California Institute of Technology at Pasadena.

Frank Bigelow, formerly general superintendent, Chicago plant, Sherwin-Williams Co., has been elected vice-president and general manager of the General Linseed Co., of that city, which now will engage in the manufacture of a complete line of paints, varnishes and enamels.

* * *

William Cooper Procter, president, Procter & Gamble Co., Cincinnati, Ohio, has endowed three visiting fellowships at Princeton University, whose incumbents are to be appointed respectively by the Universities of Oxford and Cambridge and the Paris Higher Normal School.

* * *

Howard E. Bidwell, Hartford, Conn., resident manager of the Connecticut agency of the Nat'l Aniline & Chemical Co., Inc., has resigned, to take effect March 1. He has been re-elected president of the East Hartford Chamber of Commerce.

* * *

W. B. Gilmer, formerly assistant chief chemist, Southern Cotton Oil Co., who resigned to accept the position as manager of the oil department, Tata Oil Mills, Cochin State, India, has been promoted to the general managership.

* * *

H. B. Sweatt, formerly assistant secretary, Tanners' Council of the U. S. A., succeeds Rufus M. Powell as secretary of the National Association of Glue and Gelatin Manufacturers. Mr. Powell has held this office since the organization of the Association in 1910, and will retain his connection as consulting secretary.

* * *

Dr. Mortimer D. Leonard, formerly extension entomologist, New York State College of Agriculture, Cornell University, and Firman Thompson, formerly chief chemist, Deleware Agricultural Experiment Station, constitute the directors respectively of the field and chemical research divisions recently established by the Bowker Insecticide Co., 49 Chambers Street, New York.

* * *

A. L. Pierce has resigned as president of the Solvay Process Co., and as vice-president and director of the Allied Chemical and Dye Corporation. Walter E. Frew, president, Corn Exchange National Bank, succeeds him in the latter office. E. D. Winkworth is advanced to the former office from the presidency of the Semet-Solvay Co., after 30 years' service in the organization which he entered as an office boy.

* * *

Chas. H. La Wall, of the Philadelphia College of Pharmacy and Science, Philadelphia, Pa., after four years' successful use of a 15-20 per cent. solution of commercial glucose (1½ pints of glucose to 1 gal. of water), pronounces it an effective anti-freezing material for automobile radiators and cheaper than the compositions usually recommended, which contain methanol, ethanol, glycerin, calcium chloride, etc.

* * *

Cesare Protto has succeeded Morris R. Poucher as sales director of the dyestuffs division, E. I. du Pont de Nemours & Co., who becomes an executive staff official, as does also C. A. Meade, former general manager of the dyestuffs division. F. W. Pickard, vice-president, has been relieved of his duties as a member of the executive committee to become general manager of the department, with W. F. Harrington as assistant.

Industrial Notes

Cumberland Valley Fruit Products Co., capital $100,000, Winchester, Va., will build a plant costing $60,000 to manufacture vinegar.

* * *

The Chicago Grain Products Co., manufacturer of grain alcohol, has started the erection of a power plant in connection with its distillery at Rockford, Ill., to cost $100,000.

* * *

The Grasselli Chemical Co., will expend $50,000 to erect a gas pumping station to pump natural gas from the West Virginia Lost Creek field to the company's plants at Grasselli and Meadowbrook, West Virginia.

* * *

The Thermatomic Carbon Co., of Pittsburgh, Pa., has contracted with the Federal Engineering Co., of that city for the erection of a carbon black plant to cost $300,000 at Ouachita, La., where a daily supply of 15 million cubic feet of natural gas is available.

* * *

The Fleischman Co., 701 Washington St., New York, has acquired an entire block in the Bronx, on Mott Ave., opposite Franz Siegel Park, New York City, whereon will be erected a 3-story laboratory structure, 52x165, costing $250,000. George A. Fuller Co. has the construction contract.

* * *

The Indiana Products Co. will establish at Peru, Ind., a plant for the extraction of oil from native soy beans. The project is the result of the advice of Professor Ward A. Ostrander, head of the extension service in the soils and crops department of Purdue University, and L. E. Thorne, county agent.

* * *

The Chilean exports of sodium nitrate during 1921 were 1,100,000 metric tons as compared with 2,750,000 metric tons in 1920. The collections of the customhouses during 1921 total $31,000,000 as compared with $51,000,000 in 1920. The decrease in the exports of nitrate account for this fall in collections.

* * *

Alphonse A. Lissner, manager, Foreign Section Military Sales, E. I. du Pont de Nemours & Co., returned on January 24 from Buenos Aires with the first American order that has ever been placed for ammunition by the Argentine army, which heretofore had been obtained largely from German concerns. This order for one million pounds of smokeless powder will provide six months' work for the Carney's Point, N. J., plant.

* * *

The National Starch Company's plant at Oswego, N. Y., has been sold by the Corn Products Refining Co., owner, to the Oswego Factories Corporation. The new owners will take possession on July 1 next. This plant is one of three, the other two being the Davenport, Iowa, refinery, and the Continental Candy Co., which the Corn Products Refining Co. has disposed of during the last two years, in compliance with the dissolution decree in the Government's action under the Sherman act.

* * *

E. F. Atteaux, head of the E. F. Atteaux Co., Boston, Mass., dyes, etc., has acquired the interests of L. L. [illegible] and Matthew [illegible], Boston, Mass., and R. J. Currier, Syracuse, N. Y., in the Palatine Aniline Chemical Corporation, Poughkeepsie, N. Y., manufacturer of dyestuffs, and in the future the company will be under the direction of the Atteaux organization. Mr. Atteaux has been president of the Palatine company for some time and was active in its formation.

* * *

Private railroad construction by industrial corporations is notable under a system of transportation supervision that palsies this essential instrument of service. The Tennessee Eastman Kodak Co., has acquired a 20-mile right-of-way from Kingsport, Tenn., to the Southern Railway at Hunnicutt, and is reported to have made a survey. Darco Corporation, subsidiary of the Atlas Powder Co., will build in the spring a 10½-mile railroad connecting its lignite-carbonization plant at Marshall, Texas, with its lignite deposits on the Sabine River.

* * *

The explosion of cans of bleaching powder in the hands of users of this disinfectant raised such a crop of damage actions as to compel the S. Wander Chemical Co., Albany, N. Y., to welcome bankruptcy as a relief. Ninety-two purchasers at retail alleging injuries suffered during the past three years from exploding cans instituted damage suits for $570,078, which sum, with $38,406.55 in open accounts, constitutes the liabilities. The assets include three actions for damages aggregating $1,000,000 against the manufacturers who supplied the bleaching powder.

POSITIONS WANTED

CHEMIST-SUPERINTENDENT: Canadian (32), fifteen years' experience as general analytical and consulting chemist wishes to make change. Mineralogical, metallurgical, alloys, fuel, fertilizer, etc., analysis; superintendent corn oil refinery; some chemical engineering. Now employed as chief chemist with corn starch and glucose plant. Will go anywhere. Address: "Canadian," care of CHEMICAL AGE.
L-2, care of CHEMICAL AGE.

MANAGER, Chemical Engineer, University graduate, thirty-five years of age, single, experienced in the operation and management of plants, desires to make a change offering a broader field of development. Best of references given on request. Address C-2, care of CHEMICAL AGE.

GRADUATE Chemical Engineer, ten years' practical experience in design, construction and maintenance work with several large concerns, now available. Steady, clean-cut, ambitious. I will be glad to have you check up my work. Address: L-2, Care of CHEMICAL AGE.

BUSINESS OPPORTUNITY

WANTED: A man who is thoroughly experienced in the manufacture of wood chemicals, wood alcohol, etc., to organize a chemical company for the manufacture of hard wood chemicals. Every encouragement and financial assistance, together with location of the plant, will be afforded by a corporation in central West Virginia, which owns twenty-five thousand acres of hard wood. Great shipping facilities via Baltimore & Ohio Railroad. Address "Chemical Plant," care of CHEMICAL AGE.

CHEMICAL
AGE

A CONSOLIDATION of THE CHEMICAL ENGINEER and CHEMICAL AGE

LLOYD LAMBORN, *Editor*

VOLUME 30 NEW YORK, MARCH, 1922 NUMBER 3

The Chemical Foundation, Inc.

A National Public Utility for American Welfare Through the Development of Chemical Industry

By Francis P. Garvan

President, Chemical Foundation, Inc.

SENATOR STERLING apparently did not grasp my statement that no tariff could be high enough to shut out the German products, and stated: "I have heard of prohibitive tariffs; why cannot a tariff be made so high as to stop German importations?"

Because in 1913 dye importations were $10,000,000, and that comprised 98 per cent. of our consumption. Their costs today are less than they were at that time, so that it would cost Germany $10,000.000 today to lay down on our docks a year's supply of dyes. Add to it possibly another $5,000,000 to allow for a 50 per cent. increase in consumption to cover the growth of consuming industries. That represents $15,000,000. That could be brought over in five ships and could be placed on our docks in one day.

Now in order to decide what the tariff should do, you have got to find out what it is worth to the Germans to reinstate their control of the organic chemical industry of the world. It is not a matter of competition between one manufacturer and another; it is, as the regulations of the German government I have introduced show, the combined organic chemical industry of Germany, sustained and fostered by the German Government itself, in competition with our own individual manufacturer. If you put a tariff of 100 per cent. upon dyestuffs it would cost Germany $30,000,000 to destroy our American industry, putting it in its broadest sense. That is, that it would be necessary to send a whole year's supply of dyestuffs over.

FRANCIS P. GARVAN
President, Chemical Foundation, Inc

Therefore it is that no tariff would be high enough, because no price is too high for Germany to pay. Her organic chemical industry is the cornerstone of her economic structure, and is the cornerstone of her entire foreign trade. It is the wedge which she relies upon to force all her other products into the trades of all countries.

Therefore it is not a question of merchandising at all, but it is the value to the Germans of control of the organic chemical industry of the world.

The Chairman. Your idea is that they would export and sell at a great loss in order that they might undermine the American chemical industry?

Oh yes, they would give it away, and even add a bonus to that on every pound of dye if they could get back that control, because control of the organic chemical industry means control of dependent industries in a short number of years.

The Chairman. Your thought is that if such a thing as a prohibitive tariff could be made workable, it might be better on the ground of expediency to have it in the form of a tariff rather than in the form of an embargo?

We would much rather end the whole discussion in that way, and we have searched in every possible way for a scheme other than an embargo. We know it means introducing a new form of protection, and it is just as repulsive to a Democrat like myself as to a protective tariff man. If it is repulsive to a protectionist, why not repulsive to a free trader? Yet England has adopted it; France has adopted it; Italy found she had to adopt it; even Japan is finding that she must put into effect; and lastly, Germany herself has adopted

---

Prepared from the minutes of Mr. Garvan's testimony before Sub-Committee of the Committee of the Judiciary, United States Senate, March 6, 1922, in the investigation of an alleged monopoly in domestic dyestuffs manufacture and of the activity of Americans to accelerate legislation to make America independent of Germany in organic chemical industry.

it; Germany has an embargo against American dyes today, and against Swiss dyes, and all dyes. She will not allow anything to touch her pet, that sacred industry of hers.

I do not think anybody could have been more earnest than the American interests have been to try and devise some method other than the word "embargo" or "selective embargo," or any of these unusual forms of protection.

If Senator King's references were true, that this system of protection we ask would create only one or two big companies in this country, I would take no interest in the subject whatever. It is only as it increases the number of post graduate schools in organic chemistry. There is not enough work here for all these people in dyes alone. It is only $30,000,000 gross business at the most. But every day each one of them is branching off into some new line of organic chemistry, just as quickly as they get their education, which they only can get in the development of the dye industry because of the very complicated forms of research that are necessary for the development of that industry.

You will find that the duPonts are going into the pharmaceutical business. You will find that the National Aniline is going into nitrates from the air. You will find Dr. Samuel Isermann's company going into perfumes. Others are going into tanning materials and numerous other branches of industrial synthetic chemistry.

Dye intermediates are of infinitely more importance, whose innumerable uses develop with the application of research. That is why Germany cares nothing for your tariff, or for $10,000,000, or for $20,000,000, or for that matter for $50,000,000. She wants the American mind and the American education to be shunted aside from the great development of organic chemistry. And she wants again military control of the world. What would she give to be again the master, militarily, of the world? That is the rate at which you have to fix your tariff, because let her again get a monopoly of organic chemistry of the world, plus her development of military equipment in the air, and she can take her revenge and go on with her purposes.

Right here I might advert to some accusations or insinuations that have been made by German importers or their friends or listeners, that there was something political about the formation of the Chemical Foundation. I want to say that we have been equally helped and have met about equal objection in both parties. Mr. Palmer, the Alien Property Custodian prior to my term, is a Democrat; I am a Democrat. Mr. Choate and Mr. Bradley Palmer of Boston are lifelong Republicans. The trustees of our Foundation are composed of three Republicans and two Democrats. Mr. Bannard, the chairman of the Board of Trustees, was one of the old-line Republicans of 50 years' standing, and at one time was the Republican candidate for mayor of the City of New York. Another one of the directors is Mr. Ralph Stone of Detroit. Mr. Fordney, or anybody in Michigan can tell you about his standing.

I want to say that politics has never been discussed; even today I do not know the politics of any of the employees. The Foundation was helped by the past administration, and the industry was helped by the past administration; and it has been helped just as sincerely by the present administration. Secretary Weeks, Secretary Hoover and Secretary Denby all have taken an interest in the matter. There has never been a time when there have not been Republicans for and against and Democrats for and against.

We saw free trade England put on an embargo to protect herself, and we asked for protection in America. That suggestion has not the slightest foundation, in any way, of politics, and I cannot conceive how any political issue could be made of the matter.

The first time the bill came before the House, after Kitchin had sent for me and I had offered everything I am offering you now, and he demanded to see the original charter of the Foundation, and put me through a severe examination for two or three days in his own office, all the Democrats voted for the embargo, together with a number of the Republicans. The argument at that time merely was an economic tariff argument as to whether it was a new thing that they were introducing.

We went before the Committee on Ways and Means of the House, in fact have appeared there twice, and both times they have recommended an embargo.

The Senate Finance Committee has heard us, and it recommended an embargo. There was no politics in the Foundation, no politics in the idea, and I defy anybody, speaking under oath, to point to one detail, one person who has any political interest whatsoever, who is in anyway connected with the Foundation.

We had a vacancy of a director at the beginning of this administration, and we elected Mr. Miller, my successor under this administration in the office of Alien Property Custodian, to be one of the directors. He felt afterwards that he could not serve. He put it on the ground that he was too busy; but I presume it was on account of this attack—that turned his mind away from us, although I do not know that to be the case.

As to our board, at the first meeting two years ago in the Ways and Means Committee of the House I offered to change the structure of the Chemical Foundation in any way desired. I told them it was our purpose to make it as nearly a public institution as possible and still make it efficient and effective, and if they could suggest any possible way, if they could have any lawyer in America who could point out a way whereby we could better serve the interest of the entire American people we stood ready to amend our plan in any way, shape or form necessary.

I reiterated that statement before the Committee on Finance of the Senate some six or seven months later, and I repeat it here now. If in the judgment of this committee there is any restraint that could be put upon the Chemical Foundation; if there is any change in its construction; or if you desire to have all the people connected with it step out, they are ready to do so. There is nothing but burden and responsibility there, and we are ready to do anything whatsoever, because this industry must have government support and understanding and sympathy, and that is all we want. I wish the committee to feel free to make any suggestion whatsoever to make stronger or to provide more public spirited service by this institution, or to safeguard more fully the people.

Nobody is making a cent out of it. Nobody has made a cent out of it. Although as I say after three years no one has made a nickel, and I can see no possibility of anyone ever making a nickel of it except the regular employees who get their salaries, yet I do repeat that offer.

I started out to say that that was the relation until the last time the bill came up, and then these halls have been made to ring with the whispering of "monopoly" and whisperings of "$10,000,000 worth of patents sold for $250,000," and that "the rights of the people were given away," and this, that and the other. The fact of the matter is that when the bill came before the House the last time all the Democrats voted against it, and a large number of Republicans, led by Mr. Frear of Wisconsin, voted against it, and most violent attacks were made upon the industry and upon the Foundation. And in one instance alone points the hand, or we would not have known who had accomplished that work, not unless in their bravado they had stepped forward and indulged in braggadocio.

And if you want to study propaganda, study it by its results. Senator Sterling sat here in the Overman Committee hearings. He knows that you do not find any fault with signed propaganda, i.e., signed with the name of a man who is ready to come here and take his oath and testify to what he wrote and what he says. But it is the whispering. And you take the catalogue of the whisperers and you will find it in the index of the Overman Committee—you will find that that was the thing that made us realize the situation; and it is because of that whispering that we are glad of this Committee investigation so that we may put an end to it.

And you did put an end to it when you required the taking of an oath before this Committee. It will be the last you will see of these men in this building, when you ask them to raise their right hand. The oath, plus one question: "Where did the information come from that there was a monopoly?" "Where did the information come from that there was anything corrupt or rotten, or that there was lack of public spirit in the Chemical Foundation?" If you stick to that question you will trace it home to Berlin.

Now they have spoken of the local conditions, etc., and I feel constrained to say for Mr. Choate what he will not say for himself. Mr. Choate has been paid fees by the Dyes Institute, and he has been paid fees by the Chemical Foundation. He has been the counsel of the Chemical Foundation from its inception. Mr. Choate gave two years of his services during the war without compensation. And he has received since from the Chemical Foundation $15,000 in the three years that we have been in existence, as our general counsel.

The amount of fees that he has received altogether I do not believe would pay his overhead in his firm. I know that as far as the fees from the Chemical Foundation are concerned he came to me and he said that he did not want to charge anything but he had to. He had been three years away from his firm, and he could not ask the rest of the members of his firm to carry his burden. And you know that each partner has always got to bring something in. And his services to the Chemical Foundation were worth infinitely more than he ever received.

Our only other legal expenses have been patent law expenses. They were very heavy the first year, naturally. We did not know what these patents were, or what they were about. We had to index them and gather them together, and the Houget firm's bills were quite heavy the first year. Since then we took a young man who had been donig the work in Houget's office over into our office, and paid him a salary of $4,000 a year, and then we did not have to go to the high-priced patent lawyers except for litigation, or for high-priced counsel.

Mr. Corbett is the only other high-salaried man in the Chemical Foundation. I never knew Mr. Corbett until during the war, when he was recommended to me by Mr. Wallace, who was the President of the Central Trust Company, one of our ablest bankers, now dead. And he was put into several of the companies to straighten them out, several of the German companies

Mr. Corbett became one of the officers of the Chemical Foundation, and served without pay until the time that I had to ask him to retire as vice-president—he was vice-president of the Central Trust Company—and devote all his time to this work. He served for $15,000 a year, which is a great deal less than he had ever gotten in the last ten years before. He is about to leave the Foundation and become my partner in private law practice, because he cannot afford to stay any longer with the Foundation at that price. And I think that the organization is so far developed now that possibly we can get along without that salary.

There are two or three things that will have to be called to your attention, and that is that in all this advocacy of higher protection, and keeping out German dyes, it must be kept in mind that that is directly against the financial interests, as a financial institution, of the Foundation. We lose money on it. Every particle of dye we keep out is a loss to us. We charge 10 per cent. royalty on imported dyes, whereas we only charge 5 per cent. if they make them in this country, or less in a great many of them. The maximum is 5 per cent. That is, in order to, of course, do our little bit towards encouraging American manufactures.

Now if it had not been for the German imports in the last three years these ten million dollar patents that they claim that the Foundation has would not have been able to have earned the hire of the clerks. The money with which we have been able to carry on this educational campaign in America for the development of an organic chemical industry, has been derived mainly from our royalty on the German imports. It is a part of the irony of fate that the organic chemical industry of Germany has to pay at least in part for the education of the American people.

I have the figures here, and I will give them in brief. Our total income is as follows:

In 1919 we received in royalties on domestic production, $28,787.98; in 1920, $84,251.03; in 1921, $73,188.30.

Senator Sterling.—Now, Mr. Garvan, right there. Just what do you mean by those royalties, and under or by what authority were you entitled to receive royalties? I understand you to say it is the Chemical Foundation that received these royalties.

The Chairman.—Will you follow that just a little bit, Mr. Garvan, and explain about the terms and conditions imposed upon the Foundation in respect to royalties. As of the time when the sale took place.

The Chemical Foundation bought 4,700 patents from the Government for the sum of $250,000. There was a further working capital put up by the stockholders of the Foundation, of $229,000. The Government seized these patents under the "Trading with the Enemy" Act. We first seized property and sold it as trustee. We then came back to Congress during March of 1918 and received permission by practically unanimous vote—there was only one dissenting vote in the Senate—to sell property in general. We then came back again in November, 1918, and got a specific right to sell patents. The first one was as trustee; the second was the right to sell all property; and third to make sure that we had the right to sell patents, we came back and got a special act from Congress in November, 1918.

This sale to the Foundation was made because we could not sell to an individual without creating a monopoly. Nor could we tell which one of the 4,700 patents was of any value. We could not get a legitimate buyer or a developer of 4,700 patents, nor could we pick out individual ones and sell them. If we did sell all of them or any of them to an individual purchaser he could do either one of two things: He could develop a monopoly with the natural monopoly of the patent, or he could sit back and sell it back to the Germans, or he could sit back and demand a royalty which would be, of course, larger if granted to only one individual. So that in the effort to make them public property, but useful public property, this scheme was devised. We could not just throw them open to the public, because no business man would invest his capital on the chance that you might be legislating those patents back to the Germans after he had his factory built. So that the provisions of the Foundation read that they must grant licenses to all American manufacturers. A corporation getting that license must be 75-per cent.-owned by American capital, and we must grant none exclusive licenses. And we must grant as many as there are American manufacturers who desire to take up that manufacture. And again, we must license the Government free of cost, and anybody making goods for the Government under one of these patents cannot be required to pay any royalty.

For instance, Muscle Shoals. These patents control to a large extent the value of Muscle Shoals—the Haber process patents. Now the Government can do as it pleases; it is free; and the man buying Muscle Shoals is free to go on with that development. I don't know how valuable they are. They tell me that Dr. Tolman of the Fixed Nitrogen Research Laboratory has made so much progress since the war as to outstrip the patents that are considered so valuable in the Foundation. Congress has voted two or three hundred thousand dollars to study and experiment further in those things. So that the $250,000 was an arbitrary price.

The Chairman.—How was that reached? You explained that a moment ago, but give that to us again.

It was reached by consultation between everybody. There were two branches of it. There were 5,700 patents that the Army and Navy had infringed or might have infringed, and so forth, in war material, guns and aeroplanes, etc. On those we gave a general license to the Government, with the discharge of all possible infringements or claims for infringement, for $100,000. Again an arbitrary sum. If it should be decided in negotiations that those were worth more to the United States Government than the $100,000, the outcome of negotiations will be, or Congress has it within its power to grant more to Germany. But we do not feel that Germany, having brought on the war, and compelled our Government to spend the money that we did spend in the war, that our developments should be left at the question of individual owners of patents. And therefore we closed that book as far as the situation of the navy and the war department was concerned, by giving them a general license.

Then we gave the Government a general license on all those patents that the Chemical Foundation took over, including a license for all time to have manufactured for its use, or to sell its surplus products, etc.

Under our charter the stock was 100,000 preferred and 100,000 common. The preferred is six per cent. cumulative, and the common is limited to six per cent. So that no one who ever put a dollar into the Foundation can ever get back anything more than that dollar and six per cent interest. All over and above that, if the happy day ever comes, will be spent for the benefit of chemical education in America. And we have begun to spend it before we got even that.

Senator Sterling.—That is all very interesting, indeed.

I am so glad to get a forum where I can be subjected to every possible question on the proposition, rather than to have the [illegible] of people whose interests are foreign, I believe, to our country.

I do not like to say it again, but for Senator Sterling's benefit I will say that I personally cannot and have not a share of stock even, or cannot receive a farthing as president or officer or anything else connected with the Foundation. That I have never even received an expense account, or a telephone or messenger or a hotel bill, or a dollar of any kind, directly or indirectly, through the Foundation, legal fees, or anything of the kind.

The Chairman.—The test of a good speaker or witness is that he makes you oblivious of the flight of time. It is now 1:20, I thought it was about 12 o'clock. We will adjourn until 10 o'clock tomorrow morning, Tuesday, March 7, 1922.

Conditions in Metal Mining and Recommendations for Relief

By W. R. Ingalls, Consulting Engineer

ALTHOUGH metal-mining is of immense importance, it is conducted by a small personnel, only about 150,000 men being engaged, which is the result of the mechanicalization that engineers have accomplished.* In general, the personnel obtains full-time employment. Following the war, however, we have had new and unfavorable conditions in all branches of metal mining, and how we are going to conform to them we do not yet know.

The fundamentals are to be looked for, not in our methods of doing our work, although that is a subject of great importance, but rather in the economic conditions that attach to an industry more workers than are needful, and in those that produce severe undulations in the scale of employment even among those industries that are not overmanned. The underlying cause may be summed up in the single word "miscalculations." Miscalculations are manifestly due to ignorance. Where then are we to seek the remedy? Not among politicians, for we have learned too well that in industry the hand of the government is the touch of death. Not in labor, for labor does not know enough, and the most we ask of it is not to be an impediment. Not among capitalists, purely speaking, for they are inert and about as helpless as labor.

There remains only management, which must shoulder the whole responsibility. There is no use in debating any assessments of blame between management and labor. Let us forget the word blame and assume the whole of the responsibility. This will be looking forward, not backward. What, then, does this mean and imply? The answer is simply what is expressed in this formula: *Miscalculations in industry will decrease along with increase in the transparency in industry, which tends toward the establishment of equilibrium.*

Transparency in industry means merely the acquisition of knowledge about it and thereby the ability to see through it and ahead. The basic cause of booms, with all their evils of price inflation, over-expansion, waste and inefficiency is that we fail to look ahead. In times of depression we should prepare for the future, and by doing so we can cure the depression itself. It is largely absence of knowledge of conditions, and the obscuration of vision, that prevents us from doing this.

It is vitally necessary to the industries of the country to have illuminating statistics of production and consumption, producing capacity, and all other factors, and to have such statistics promptly available. The position of the business man who does not have all the needful facts is like that of the automobilist who undertakes to drive without headlights.

*From address at annual meeting of Mining and Metallurgical Society of America and American Institute of Mining and Metallurgical Engineers, New York City, Feb. [illegible], 1922.

The Chemist in the Dyeing and Cleaning Industry

By Ruth O'Brien

Associate Professor of Textile Chemistry, Iowa State College

THE chemist in the dyeing and cleaning industry does not yet exist. He is worthy of consideration only because he will arrive tomorrow. The industry itself is not yet a chemical one. It is interesting because it will be tomorrow. Moreover it is the far-sighted chemist, with the vision of future possibilities, who tomorrow will be the chemist in the dyeing and cleaning establishments of the country.

RUTH O'BRIEN
Associate Professor of Textile Chemistry, Iowa State College

Dry Cleaning

Economically, the industry is one large enough to warrant more than a passing regard. The latest census report gives the number of establishments in this country in 1919 as 2,156. They employed 18,598 wage earners and received $54,030,000 for work done. This report includes only those operated by mechanical power and also does not list the dry cleaning being done by laundries and other establishments engaged chiefly in other industries. The total production given for these was $1,002,000. The National Association of Dyers and Cleaners, with headquarters in St. Louis, now numbers approximately 1,100 plants in spite of the fact that their requirements for membership include the maintenance of an underground storage system for the solvent used, buildings especially constructed for fire protection, etc.—requirements with which many of the small cleaners can not comply.

Chemically, the industry is unique in that it deals exclusively with the action of chemical reagents upon mixtures of chemical compounds (textile fabrics) and yet its directors number almost no real chemists. The average cleaner who has gained success has done so by sheer trial and error. The phenomenal advance of the industry is due to the admirable courage and business skill of the owners. There is no doubt that this also has been due to the fact that in the past a plant could be conducted in a passable manner upon almost any scale and yield returns large enough for a living wage.

A man with a tub of gasoline in the back yard (if the fire regulations permitted), a wife to help with the pressing and a son to drive the delivery wagon could and today does do a respectable amount of business. Moreover, if he works in a reasonably conscientious manner (and does not burn himself or his establishment) he can become a serious competitor of the larger plant. In fact, it has been the pressure brought to bear upon the larger plants by these small cleaners and by the ever-present tailoring shops which do a little cleaning on the side that is now forcing the larger establishment, such as those listed in the census report, to a research attitude and an appreciation of the value of the chemist in their business.

The need of the chemist in such a plant can be best expressed, perhaps, by a brief outline of the processes involved in a modern establishment, and the apparent tendency toward their improvement. When a garment is received it is first properly checked and sorted. Then, with or without preliminary dusting and drying, it is taken to the dry cleaning room and transferred with other members of its class to a mechanically-driven washer. There is little doubt but there could be much improvement made in the preliminary treatment of almost all garments, and there is no doubt but what the washers now used could be improved greatly. These are in most cases constructed primarily for the laundry, and changes better adapting them to dry cleaning work are greatly needed.

The solvent usually used is gasoline—the quality depending upon the location of the plant and the resultant availability of the supply. A much disputed question at the present time is the substitution of benzol for gasoline. Of course, in some parts of the country the inconvenience of obtaining benzol and the resultant higher price may be prohibitive for some time to come. But, putting aside these economic problems which may be changed very radically in the future, very little real investigation has been attempted to determine the relative value of the two solvents for general or specific use, the proper method of using benzol for this purpose either from the standpoint of the maximum cleaning produced, the solvent recovery, or the health of the worker in the plant. No other solvents are being used on a large scale today. What will be the solvent of the future?

Aqua ammonia or the so-called benzine soaps may be added to the solvent. The amount of ammonia, the amount and kind of soap and the time of washing are usually merely matters of custom—traditions handed down in the plant—and the success of the process depends entirely upon the judgment and skill of the man in charge. The most nearly scientific method now in use is the continuous clarification system. In this case a centrifugal clarifier is attached to the washer and the gasoline pumped from the washer to the clarifier where it is purified and returned to the washer. By means of a sight glass it is possible to see when the load has been cleaned. However, this process may be greatly improved; perhaps along the lines of the closed system, where an atmosphere of inert gas lessens the possibility of fire, which is in use in two or three American plants and in quite a number abroad.

In the usual plant the dirty gasoline is drawn off and purified either by distillation, or caustic soda or centrifugal clarification. The method used varies with almost every plant. Comparative studies as to the most efficient method, the introduction of new clarification compounds and general scientific control seem to be lacking. After rinsing, the garments are removed to an extractor, then dried in a tumbler, the exact type of which may be considerably improved at present, and conveyed to the pressing room. Here the spots are removed, wet cleaning is resorted to if necessary and practicable, and the pressing done.

The spotting table is another place where the advice of the chemist may be used to advantage. Some of this work is, of course, a matter of trial and error, as it is often impossible to determine the exact nature of an unknown spot. But the textile material is essentially chemical in nature, the reagents are chemical and stain removal is largely a chemical process. It is, therefore, obvious that chemical information might well supplement practical experience.

It is impossible to mention all the problems in dry cleaning which need chemical supervision. There is glove cleaning—so important that large plants are devoted exclusively to that work. The cleaning and finishing as well as dyeing of these involves a wide application of leather chemistry. The rug department, where cleaning, dyeing and sizing are all important, hat and fur cleaning and many other fields present problems rarely considered by chemists.

Dyeing

However, at present the indications are that real scientific control will develop first in the dye house. In a few plants this already has occurried. Of course much of the dyeing done is small piece work, dyed to sample. This may always be done in the small kettle, where its success depends upon the experienced dyer with his color-matching talent, though we hope for the day of exact color measurement when color standardization will bring more reliable methods. However, the large dye house does a considerable volume of standard color work—dark blues, reds and browns. In such cases the color stripping and the application of the new dye can be done in a very well controlled manner. In fact it may be done by machinery, the formulae being determined by the chemist in the laboratory and the work in the dye house reduced to the mere execution of instructions and the supervision of a number of machines. This will undoubtedly be the case in most plants before many years. The present tendency of the small dyer is to send more and more of his work to the wholesale dyer and the resulting increased volume of work so done will necessitate such a system. Thus the responsibility of the dye house will be in the hands of the color director—a chemist.

All of this will call for a great deal of research. The problem of the man who removes the color from an old garment and redyes it or tops a color on the old garment is quite different from the problem of the mill dyer. At present his methods are largely empirical and have been gained by years of experience—methods hand to hand on to an uneducated apprentice. In fact one of the chief factors which is opening the door of the dye house to the chemist is that the majority of present-day dyers are elderly men who have no adequately trained understudies. The spirit of this country has never fostered the development of craftsmen by long years of apprenticeship. It is the chemically trained person with the ability and the imagination to apply that training to the industry, who will take his place—under new conditions.

It is lamentable to be compelled to close a paper such as this without being able to announce that many plants are now waiting and longing to hire chemists. It is especially lamentable at this time when chemists would enjoy being hired. Unfortunately, the cleaning business along with many others is suffering from the prevailing depression. They will not employ many chemists this year—perhaps a very few next year; but the encouraging fact is that this very depression is showing them the need of scientifically controlled methods, and the attitude toward research is very gratifying.

This was shown very decidedly by the enthusiastic attendance of the cleaners themselves at the two short courses conducted for their benefit in the State Colleges of Iowa and Oklahoma this year. The industry has always been marked by good business methods, and that spirit will govern its future policies. It will be well for the American chemist to inform himself a little upon the field of textile chemistry—a field of application and research which has been woefully neglected in this country.

Silicate of Soda in Flakes

By D. M. Goetschius

Engineering Chemist

I read with a great deal of interest in February Chemical Age, the article entitled "Silicate of Soda in Flakes," and naturally so as will appear from the brief narrative of my own experience and observation in the manufacture and use of this important heavy chemical.

About thirteen years ago, being then in charge of silicate manufacture for a New Jersey corporation, I was engaged in experimental work on exactly the lines described in this article, carried out in collaboration with a large vacuum drier company. The process used was identical in principle with that which Mr. I. D. Lihme of the Grasselli Chemical Company has worked out, and it produced silicate as he describes it, readily and conveniently soluble.

After getting our product, however, we ran into a trouble that no subsequent work was able to remedy, and which prevented our putting it on the market. When the flakes were placed in packages, large or small, packed tightly or loosely, under any conditions of atmosphere we were able to get, they sooner or later adhered strongly to one another in such manner as to leave them unavailable for solution or any other practical purpose.

Silicate of soda, dried without dehydration, has the peculiar property of "flowing." That is to say: Individual pieces, large or small, apparently rigid and permanent in shape, will deform under pressure or even by their own weight, and if in contact will adhere one to the other. In fact, they "flow into" each other. I have seen a pile of chips of dried silicate cut from the inside of a container, and so hard that the edges would act like a knife on the hands, settle together in a few days into a solid mass in which few separate pieces were discernible.

And that is what we found happened with the vacuum-dried flakes. Varying with conditions, there was a coherence within and adherence to the containers within a few weeks, with eventual coalescence to a horny mass occupying about one-third of the original bulk. I repeat that we found no way to remedy this. I hope that Mr. Lihme has found it, or will, for the product has great potential value.

Silicate of soda, with its manifold compositions and remarkable physical properties, has not yet come into its own and is deserving of much research work in the line of innumerable applications.

Water Resistant Glues: Casein and Blood Albumin

By Robert Herman Bogue
Industrial Fellow, Mellon Institute of Industrial Research of the University of Pittsburgh; Research Chemist, Armour & Co., Chicago.

MANY attempts have been made to produce an insoluble and water resistant glue from ordinary animal glue by the addition to it of some "hardening" reagent. Formaldehyde and potassium bichromate have been used for this purpose, and although they do produce a product that is nearly insoluble and that swells to a much smaller extent than the untreated glue, yet joints made by them fail to retain their strength when subjected to a drastic treament with either cold or hot water. The glue in the joint is still capable of imbibing water from a humid atmosphere or from rain, for example, to a degree that makes them unsafe for general waterproof service.

ROBERT HERMAN BOGUE
Fellow, Mellon Institute of Industrial Research; Research Chemist, Armour & Co.

To be satisfactory as a water resistant material the glue must not only be insoluble but must also retain a fair degree of its original strength upon subjection to severe water treatment. A slight swelling of the glue in the joint is not permissible as a dangerous weakening inevitably results therefrom. The only glues that have proved satisfactory for water resistant purposes, and that are strong enough for the best joint and veneer work, are casein and blood albumin glues.*

Casein Glue

The use of casein as an adhesive had, prior to 1918, been confined almost entirely to a few trades and districts in Europe where it had found a limited application in bookbinding and cabinet work, but large scale production was unknown. Casein had, however, been used in quantity in the sizing and coating of paper for many years prior to the war. The material was imported mostly from South America in the dry state as natural casein, and brought into a thin creamy solution before use by dissolving in a weak solution of ammonia, soda ash, or borax. Reed furniture is often sized with casein glue to give it a light creamy, rather than amber tone.

In July, 1918, a committee of technical men appointed by the U. S. Shipping Board first seriously considered the possibilities of casein as a basis for waterproof glue. The need for such a product came primarily from the Bureau of Aircraft Production. Ordinary types of animal glue, or other types that were in common service, as marine and vegetable glues, were sufficiently strong for all purposes under ordinary conditions of weather, but when exposed to water or even to a highly humid atmosphere for some time they became weak due to the absorption of water, and the consequent swelling which they underwent. This objectionable feature of animal glues could be overcome largely by the application of a waterproof varnish or lacquer over the surfaces exposed, but such a practice seemed not to be practicable in all cases. Propeller blades were treated in that manner with success, but the plywood entering into the construction of the craft could not be treated satisfactorily, and a weakening and separation of the layers of wood occurred.

The need for a waterproof glue became, therefore, very urgent. Representatives of the Army and Navy estimated an annual requirement of 3,000,000 pounds,[1] and there was at the time only one plant in the country manufacturing a casein glue. To further augment the difficulty it was known that different makes of casein were very dissimilar in their adaptability to glue manufacture. In short a practically new industry was to be initiated for an immediate large-scale production, and a uniformity of high-grade product, previously unattained even in small-scale production, must be developed.

Manufacture of Casein

The only source of casein is milk.* It occurs as the principal protein of the milk in the form of the calcium salt, and in this form is suspended as a colloid. Approximately 3 per cent. of cow's milk is casein. Whenever any acid is introduced into the milk the calcium caseinate is decomposed forming the ions of the inorganic calcium salt, and uncombined casein. This uncombined casein is insoluble, and separates from the remaining liquid as a curdy precipitate.[2]

Lactic Acid or Natural-Sour Method

In the natural souring of milk the *bacterium lactis acidi* attacks the lactose of milk sugar producing lactic acid, and this acid functions as above bringing about the coagulation of the casein.[2] Whole milk is never used since the separation of the fat and its utilization for butter is a necessary economic part of the milk industry. Buttermilk is sometimes used but skim milk is best. The milk is allowed to stand at room temperature until the lactic acid fermentation has proceeded to the point where the curd begins to separate from the whey, and then warmed to 130° F., when the separation becomes complete. After draining off the whey the curd may or may not be washed with cold water. The curd is squeezed in cloth bags to remove as much of the liquid as possible and dried by spreading on trays in a drying alley through which air at a temperature of about 130° F., is circulating. It is then ground and is ready for use.

Fresh skim milk is sometimes soured rapidly by mixing a stream of it, as it falls into a tank, with a second stream of the whey that has been run off from a batch previously treated.

---

*This article represents a part of the section on "Water Resistant Glues" in the writer's forthcoming book on "The Chemistry and Technology of Gelatin and Glue," to be published by the McGraw-Hill Co., N. Y., in the Summer of 1922.

*The Dairy Division of the Bureau of Animal Industry and the Forest Products Laboratory of the Department of Agriculture have studied the problem, and the literature upon the subject is confined largely to these two stations.

[1] *Cf.* W. M. Clark, *J. Ind. Eng. Chem.*, *12* (1920), 1162.

[2] Batterman, *J. Ind. Eng. Chem.*, *12* (1920), 111.

Dahlberg[1] has reported an "ejector" method developed by the Bureau of Animal Industry. The milk is allowed to sour until its acidity, expressed as lactic acid, and using phenolphthalein as an indicator, is 0.8-0.9 per cent. It is then allowed to run out of the tank through an ejector where it is heated rapidly by introducing steam, and falls into a second tank. The curd collects on the top and, after draining off the whey, is washed, pressed and dried as above.

Acid Coagulation Method

Much time may be saved by adding an acid directly to the milk rather than to allow the bacteria to produce the required acidity. The greater part of the casein manufactured in this country has been made by this process, although the grain-curd method described later offers such great advantages that it will probably soon be the leading procedure. The fresh skim milk is heated with steam to a temperature of 120° F., and sulfuric acid added to the extent of one pint of acid (Sp. Gr. 1, 84) mixed with a gallon of water to each 1,000 pounds of milk. The mixture is stirred until the curd separates, when the whey is drained off, and the curd washed, pressed, and dried.

Instead of finishing in the above manner, the curd is sometimes covered with water and brought to 170-175° F. This causes the curd to collect into a semi-fluid, plastic, tough mass. The water is drained off, and the soft curd barreled and shipped in that form. Hydrochloric acid is substituted for the sulfuric acid in some creameries where the whey is subsequently treated for the recovery of lactose, as the latter acid introduces mechanical difficulties in that separation.

Rennet Coagulation Method

The casein of milk also may be coagulated by treatment with rennet. This method does not appear to be in favor among manufacturers, chiefly, perhaps, on account of the very high ash-content of the resulting casein, and, as will be shown later, the ash-content has much to do with the properties of the product in glue manufacture.

The Grain-Curd Method

When it became imperative to manufacture large amounts of casein of a high quality for waterproof glues the several methods in use were examined and none of these seemed properly adapted to the purpose. The natural-sour method was eliminated on account of its slow action. Sulfuric acid precipitation was undesirable because of the precipitation of calcium sulfate which interfered with the lactose separation. High temperature methods were rejected on account of complications which made them difficult to control. Precipitation with hydrochloric acid remained but this method previously had yielded very poor casein. Van Slyke and Baker[2] had improved this method, but the product was very finely divided and could not be handled properly in large quantities. The hydrochloric acid precipitation method was accordingly studied by the Dairy Division of the Bureau of Animal Industry, and a new procedure, designated as the *grain-curd* method has been reported by Clark, Zoller, Dahlberg and Weimar.[3]

The new method makes use of the fact that casein is an amphoteric electrolyte, having its isoelectric point at $_{p}$H 4.6. At this hydrogen ion concentration the casein is not only more insoluble than at any other point, but it is also uncombined with any cation or anion in the solution. This in milk casein is in the form of calcium caseinate, and at any $_{p}$H greater than about 4.6 some of the calcium must remain in combination with the casein, and no amount of washing could liberate it. The amount of the calcium so combined is proportional to the extent the $_{p}$H diverges from 4.6, and at the latter value it is theoretically zero, so that by proper washing at that $_{p}$H, practically all of the calcium may be eliminated, and a product of very low ash is obtained. The significance of this will be explained later.

The authors of the process found that methyl red could be used in plant practice with remarkable success for the control of the acidity of the milk. Methyl red does not indicate correctly in the presence of whey, but it was observed than an apparent $_{p}$H of 4.6, which was by electrometric methods actually only 4.1, produced a casein curd of the particular resiliency and consistency most favorable for washing and handling.

If this curd were then washed, after draining off the acid, with water, especially if any alkaline salts were present, there would be a tendency to redispersion of the casein and loss of resiliency and porosity of the mass upon which efficient commercial washing depends. For this reason the wash water must also be acidified to the same $_{p}$H as the casein, and hydrochloric acid is used for the purpose, methyl red again serving as the indicator.

Buffer solutions are recommended for the standard in comparisons, the phthalate-sodium hydroxid buffer solutions of Clark and Lubs[1] being most convenient. A color comparator may be used if desired.

Government Specifications for Casein

The government specifications[2] require that all casein used for making water-resistant glue for use in airplanes should pass the following tests:

Color: White, or light cream.
Odor: Nearly odorless, with not more than a trace of sourness.
Moisture: Not more than 10.0 per cent.
Fat: Not more than 1.0 per cent.
Ash: Not more than 4.0 per cent.
Nitrogen: Not less than 14.25 per cent.
Acidity: Not more than 12.5 cc. N/10 alkali per gram.

Influence of Method of Manufacture

The caseins commercially available range in quality from almost pure white, sweet material, low in ash and other impurities, to a dark brown substance, which may be very sour and give off an offensive odor. A peculiar anomaly among manufacturers of casein glue lies in the preferences that some have to a casein made, for example, by the natural-sour process, while others can obtain satisfactory results only by the use of a product that has been precipitated by mineral acids.

Analyses of Casein Made by Different Methods[3]

Method	Moisture per cent	Fat (Moisture free basis) per cent	Ash (Moisture free basis) per cent	Nitrogen (Moisture fat ash free basis) per cent	Acidity cc.
Buttermilk	6.97	0.56	1.36	14.77	9.2
Grain-curd	9.18	0.23	1.65	14.84	9.9
Natural sour	7.87	0.27	2.16	14.84	8.7
Sulfuric acid	7.81	0.35	4.05	14.46	7.6
Sulfuric acid cooked	8.89	0.12	4.25	15.04	5.9
Hydrochloric acid cooked	9.44	0.18	4.71	15.03	5.2
Hydrochloric acid	7.10	0.16	5.74	14.52	6.7
Rennet	8.20	0.63	7.95	14.41	7.9

Acidity is expressed in cc. of N/10 sodium hydroxid solution required to neutralize 1 gram of moisture-, fat-, and ash-free casein and give a product neutral to phenolphthalein.

---

[1] U. S. Dept. Agr. Bull. 661.

[2] Van Slyke and Baker, J. Biol. Chem., 35 (1918), 127.

[3] W. M. Clark, J. M. Zoller, A. O. Dahlberg and A. C. Weimar, J. Ind. Eng. Chem., 12 (1920), 1163.

[1] W. M. Clark, "The Determination of Hydrogen Ions," Baltimore (1920), pps. 75-6.

[2] Department of the Navy, Bureau of Construction and Repair, [illegible], January 16, 1919.

[3] S. Butterman, *J. Ind. Eng. Chem.*, 12 (1920), 141.

A chemical examination of the caseins produced by the several methods of manufacture show (1) fairly uniform results for a product made in any given way, but (2) widely different results between products made by different methods. The preceding table illustrates this. The analysis under each method is entirely representative of that particular procedure.

One of the most apparent differences observed between caseins manufactured by the three commercial methods—lactic acid, mineral acid, and rennet—was in the different amounts of water required to produce glues prepared from them of the same viscosity. Butterman[1] concludes that "in general, caseins of the same type require a quantity of water which varies within a definite range and is somewhat sharply differentiated from the quantity required by other types. Indeed, in most cases, (except in caseins made by the method of Sammis or by the grain-curd method) it is possible to name the method of manufacture by a mere observation of the relative amount of water required by the casein under investigation." By an exhaustive comparison Butterman established the reason for this. He found that the higher the ash-content of a casein, the greater the dilution at which it must be mixed to give a standard viscosity, and also the shorter will be the "life" of the product. By "life" is meant the period of time between the preparation of the glue and the point where it becomes too thick to spread properly. These points are illustrated in the following table of average values:

Effect of Ash-Content on Properties of Casein Glue.

	Ash per cent.	Water: casein ratio	Life Hours
Grain curd....................	1.8	2.3	12
Lactic acid....................	2.5	2.4	10
Mineral acid..................	4.0	2.8	7
Rennet	8.6	3.9	5

By plotting the ash-content against the water-casein ratio Butterman obtained a curve from which he derived an equation of the general type: $y=Mx+c$. Hence if A is the ash-content of the casein, and W the water-casein ratio required to give a glue of medium viscosity, the glue formula 4 gives the equation[2]: $W=0.24\,A+1.85$. It is therefore possible, by making a determination of the ash content of any casein, and applying the results to the equation, to tell at once the proper proportion of the ingredients required to mix it into a satisfactory glue, regardless of the method by which the casein has been made, and by that means to casein has been made, and by that means to be certain of uniform results.

The control of the ash content of the casein lies in two factors: the hydrogen ion concentration to which the milk is brought during the precipitation, as already described; and the washing which the curd receives. If the proper $_pH$ is maintained, the ash content decreases directly as the amount of washing it receives. It is easily possible, in the grain-curd process, to bring the ash down to about 1.7 per cent. by only two washings, and in plant practice it should not rise above 2.5 per cent.

Clark[3] has further shown that all caseins change weight very rapidly by absorption or loss of water when subjected to atmospheres only slightly different from the normal. In cool dry air they lose weight rapidly, while in warm moist air they quickly increase in weight. At humidities between 85 and 95 per cent. the absorption of moisture is so rapid as to become "dangerous." The grain-curd caseins are, however, shown to be superior to any of the other types in that they respond more slowly to changes in atmospheric conditions, and tend to retain a smaller quantity of moisture. Casein that has been subjected to a high temperature treatment is most sensitive to increases in humidity, and also tends to retain the moisture more firmly than the other types. The ash-content is not held responsible for these changes in water absorptive capacity, but rather the effect of heat upon the casein molecule.

Preparation of Casein Glue

Casein is insoluble in pure water, but in the presence of any alkali will pass readily into a colloidal solution. Lime is most commonly used. Casein, water and lime will produce a glue that has good water-resistant properties, but it sets rather rapidly into a thick paste which cannot be easily worked. It is therefore said to have a short life. Several other ingredients have been proposed to be added to the mixture to increase the life and otherwise improve the properties of the glue. Formulas have been patented involving the addition of sodium silicate, sodium hydroxid, and sodium fluorid. Oils are sometimes added to prevent dusting.

Casein glues may be designated as the dry-mix and the wet-mix types. The dry-mix glues are prepared by the glue manufacturer from formulas which are not made public, and shipped in dry form. These are prepared for use according to specific directions. The wet-mix glues are made up by the consumer from the raw casein, lime, and other ingredients.

Casein Cements

Prior to the war there had been a number of casein cements suggested which were being employed to a limited extent as water-resistant glue. Typical of these may be mentioned the following:

One part of Gum Arabic is dissolved in 5 parts of 40 per cent. water glass and evaporated on the water-bath until sufficiently dry to grind. It is then ground to 50 mesh, and mixed with 150-mesh calcium hydroxid and 40-mesh casein in the proportions:

Gum-silicate mixture	20 parts
Casein	40 parts
Calcium hydroxide	25 parts

This mixture is then made up with water in the proportions of 45 parts dry mixture to 100 parts of water. Another typical formula is as follows:

Casein	47 parts
Calcium hydroxide.	29.5 parts
Sodium silicate	15.5 parts
Gum Arabic	8 parts

A formula developed at the Forest Products Laboratory[1] using sodium silicate has proved especially satisfactory. It is specified as follows:

Formula—Glue No. 4-A.

$$\left.\begin{array}{l}\left.\begin{array}{l}\text{100 parts casein}\\ \text{130 to 280 parts water}\end{array}\right\}\text{soak 15 minutes}\\ \left.\begin{array}{l}\text{15 to 22 parts hydrated powdered lime}\\ \text{90 parts water}\end{array}\right\}\text{mix}\\ \text{70 parts silicate of soda}\end{array}\right\}\text{mix}$$

This formula is prepared as follows:

The proper quantity of water is introduced into the glue pot, and the mixing blade is brought into action at a speed corresponding to about 50 or 60 revolutions per minute. The stirring is allowed to continue during the addition of the casein to the water and for a few minutes thereafter until the mixture becomes mush-like in consistency through the absorption of the free water by the casein. The blade is then stopped and the mixture allowed to soak.

After a period of 15 minutes the soaking is considered complete and the mixing blade is again brought into action. The lime water mixture is now added and two or three minutes later the silicate of soda is introduced.

---

[1] S. Butterman, *J. Ind. Eng. Chem.*, *12*, (1920) 141

[2] The equation would vary slightly with any variation in the formula used.

[3] W. M. Clark, *et al*, *loc. cit.*

[1] U. S. Patent No. 1,291,369 granted to S. Butterman and assigned to the United States [illegible]

The mixing is allowed to continue for from 20 minutes to one-half hour after the addition of the silicate of soda, whereupon a smooth, freely flowing mixture, of uniform texture and free from lumps, should be produced.

No precise quantity of water can be prescribed because of the variation of the water-absorbing qualities of different caseins. The criterion of whether or not the proper quantity of soaking water has been added is the viscosity of the finished (mixed) glue. If its consistency is too thin, an excess of water beyond that required has been used, and it is best to reject the batch and try again. Similarly, if the consistency is too thick and heavy, an insufficient quantity of water has been used. The water required for various types of casein lies in the following ranges:

Lactic acid casein	130 to 170 parts water
Sulfuric acid casein Hydrochloric acid casein	170 to 220 parts water
Rennet casein	280 parts water

The silicates of soda that may be used in the formula are the ordinary liquid water glasses, and should lie within the following analytical limits:

Specific gravity	1.38 to 1.42
Density (Baumé scale)	40.31 to 42.96
Sodium oxide, per cent	9.38 to 9.88
Silica, per cent	31.41 to 32.38

The Air Board specification employed a formula differing from the above by substituting sodium hydroxide for a part of the hydrated lime, omitting sodium silicate, and introducing sodium fluorid and paraffin oil. It is made up as follows:

Casein	100 parts
Freshly slaked lime	18 parts
Commercial sodium hydroxide (not less than 95 per cent pure)	11 parts
Sodium fluoride	3 parts
Paraffin oil	1.5 parts

The above are mixed dry and are prepared for use by mixing with 200 to 250 parts of water.[1] This mixture has the great advantage over those previously mentioned in that it acquires a very smooth and limpid consistency which remains in a workable condition for much longer periods of time than any to which sodium fluoride is not added.

Sodium Fluoride

The utilization of sodium fluoride in casein glue was probably first introduced for the prevention of the growth of mold or bacteria, and its exceptional value as a liquid stabilizer was discovered only by accident. That it not only possesses such a value, but also is quite unique in this respect seems indisputable. Intensive research has seemed to indicate that the influence of the fluoride ion is specific. It is probable that the sodium fluoride and calicum hydroxide react with each other to some extent forming sodium hydroxide and an insoluble calcium fluoride. There seems, however, to be some kind of a solvent action on the casein that is peculiar to the sodium fluoride. Of course, almost any sodium salt that will form sodium hydroxide by double decomposition with calicum hydroxide will dissolve casein, but the interaction with sodium fluoride seems to give a glue of better consistency, higher lustre, greater water resistance, and especially longer life than any other salt. We understand that there is at least one American manufacturer who is producing a casein glue in the liquid form which will remain in such a condition indefinitely.

The effectiveness of sodium fluoride as a preservative is not as marked as might be expected. The employment of Beta naphthol is finding especial favor as a most efficient preservative. About 2 per cent. is used, based on the dry casein content of the glue. Since Beta naphthol is insoluble in cold water, it is necessary when using it to heat the mixture after the addition of the water.

Blood Albumin Glue

Blood albumin glue, like casein glue, was practically unknown prior to 1918, but the sudden and imperative demand for water-resistant plywood for military purposes resulted in an intensive study of all possible sources of waterproof glues, and casein and blood albumin were found to be most satisfactory for this purpose.

Blood albumin glue is not placed upon the market in a prepared form chiefly on account of a decrease in the solubility of the albumin with age. But it may be prepared without any difficulty by the consumer from either fresh blood or the dried albumin. If fresh blood is to be used the supply must be readily accessible to the consuming plant, for decomposition takes place very rapidly which unfits the material for glue purposes. It is more commonly prepared from the dried soluble albumin which is produced at the larger slaughter houses. This is made by coagulating red blood corpuscles and the fibrin and subjecting the clear serum to evaporation under reduced pressure. The temperature must not be allowed to rise above 160° F., as at that temperature the albumin coagulates. The resulting solid residue is ground and sold as dried soluble blood albumin. As the solubility diminishes with age the albumin should be used as a glue only when reasonably fresh.

Preparation of Blood Albumin Glue

A glue may be made that is satisfactory for some purposes by simply dissolving the albumin in water, but the desirable qualities are improved by the addition of ammonium hydroxide and lime, and still other ingredients may be added. If too much lime is used, however, the glue will set very rapidly to a stiff jelly that is not workable.

In putting the material into solution it is advisable to allow it to soak for about two hours before stirring. Water at about 70-80° F. should be used. After it is thoroughly soaked it should be agitated until it is of a uniform consistency. There will usually be some insoluble material that will not go into solution, but unless it is excessive in amount or is particularly coarse it may be neglected. It is sometimes advisable, however, to strain the mixture through a screen of about 30-mesh wire before using. Blood albumin glues must not be heated in their preparation.

A formula developed by the Forest Products Laboratory[1] for the preparation of blood albumin glue has been found very satisfactory. This is specified as follows:[2]

6 parts of black soluble blood albumin (90 per cent solubility).
11 parts of water at about 80° F.
¼ part of ammonium hydroxide (Sp. Gr. 0.90).
⅙ part of hydrated lime (2.8% of the albumin.)

After the blood has been put into solution, the ammonia is added while stirring the mixture slowly. The lime is then added in the form of a thick cream, and agitation should be continued slowly for a few minutes. Care should be exercised in the use of the lime, inasmuch as a small excess will cause the mixture to thicken and become a jelly like mass. The glue should be of moderate consistency when mixed and should be suitable for use for several hours. The exact proportions of albumin and water may be varied to produce a glue of greater or less consistency or to suit an albumin of different solubility than that specified.

Glues made from blood albumin tend to foam in the spreading machines, but if the spreader is allowed to remain stationary except while panels are actually being coated with glue, they may be satisfactorily operated.

---

[1] [illegible]

[1] Patent applied for in the name of S. B. Henning, Forest Products Laboratory.

[2] U. S. National Advisory Committee for Aeronautics Report 66 (1920) 16.

Principles of Organization and Management

Advice to Plant Executives and to All Industrial Workers Aspiring to Administrative Responsibilities

By Wallace Attwood

ORGANIZATION is the proper adjustment of the relationship between human beings in an effort to accomplish certain definite ends. The degree to which this adjustment is correct, logical, and on sound lines determines the resultant success of the organization. It is animate rather than inanimate. A business is a living, pulsating organism, which should function methodically, without confusion, delay, or misinterpretation, yet with a flexibility which allows for the initiative of the individual. Good organization implies clearly-defined plans and ideals, and efficient co-ordination and co-operation of capital, labor and management in carrying them out.*

Good management will look to the development and direction of the great sources of power in the personnel of the business, so that each member contributes his quota to some constructive plan. The resultant should be the exact control of the business, so that there shall be the maximum of efficiency.

The ideal of an efficient organization is, then, that of man-building. Surely this is high enough; but in order to make the ideal practical of attainment it must find expression through a type of organization which will recognize and apply correct principles, laws and rules.

Importance of Sound Organization

The evolution of industry and commerce has long since carried us beyond the limitations of the one-man business. Business activities are now extremely complex, whether looked at from the standpoint of a single business or industry, or the interplay between associated industries—national or international. Without proper organization there would be chaos.

There is no doubt that the conditions which present themselves so plainly to us in the aftermath of the war will force efficiency in organization and management. We must organize ourselves for action, just as we did during the war. Industrial conditions will not be stabilized by a single influence, but only through the adoption of a program of constructive betterments by each industrial concern.

There is a remarkable lack of knowledge of what we might term "the mechanics of organization." Most organizations are a good deal like Topsy, who "just growed." Capital, labor, management—it is the co-operation of these three, through sound organization, that tends to the greatest success in modern business. Since the flow of influence in an industrial or commercial, in contradistinction to that of a political organization, as a democratic society, organization is from the top downwards, it is evident that increased efficiency will be most quickly secured by applying efficiency principles in the first place to the personal operations of executives, managers, and so on. It is important, therefore, that the elements of good management must provide for:—

(1) The systematic use of experience.
(2) Economic control of effort.
(3) Promotion of personal efficiency.

Coming more strictly to the ideal business organization, we must so construct it that we have: —

(1) Management and Men working in complete harmony.
(2) Centralization of functions that group themselves naturally.
(3) The Line of Control, Authority and Responsibility, operating from executives downwards—avoiding (a) divided authority, (b) duplication, (c) bottle-necks, (d) blind alleys, and (c) breaches or misfiring.
(4) No man responsible to more than one superior for the same function.
(5) Pyramidal support from the bottom upwards.
(6) Co-operation and co-ordination inter-departmentally.
(7) Elasticity which will allow for the expansion of the business.
(8) A line of progress which will allow for the growth and initiative of the individual.
(9) The three-positional plan whereby each person is (a) carrying out his own work, (b) training the man below him, and (c) understudying the man above him.
(10) An organization which will give expression to the personality of the business.

Purpose of Organization

When an efficient organization has been created in a business, department, or section, we may expect it to

(1) Co-ordinate all the functions of the business to one end—that of rendering efficient service to the community we are seeking to serve.
(2) Keep the business in touch with all outside developments.
(3) Define clearly functions of each activity within the business.
(4) Carry out the clearly defined policy and ideals of the business.
(5) Give scope for growth for every individual in the business, and, by expansion, to create openings for further helpers.
(6) Give the square deal to Capital, Management, Labor and Customer.

Scientific Method for Executives

To be properly organized, a business must be run on scientific lines. It is important, therefore, since the organization is no stronger than the combined efforts of the individuals composing it, that each person—and more especially the executives—must carry out work by scientific methods.

Business activities to-day demand exactness and standards by which to measure achievement. Such standards must cover the individual, the products, the methods, and the working conditions. The scientific method calls for an inquiry into the ratio between practical accomplishment and theoretical effort. The executive must

(1) Set standards for every unit in the organization.
(2) Plan all work intelligently; in general, for long periods ahead, and down to the minute detail, for early accomplishment. Then stick to the plan.
(3) Prepare all working conditions so that every facility is available for the successful accomplishment of the work to be done.
(4) Compile accurate records with a view to confirming work done as assistance for future activities.
(5) Limit the amount of detail work for himself, thus leaving him free to control, analyze and supervise the work of others under him.
(6) Make known where the responsibility and authority of those under him begins and ends.
(7) Standardize the duties of his subordinates and place these duties in the hands of those competent to handle them.
(8) Organize his work so that his absence for a time will not be felt.
(9) Work always on the law of exception, investigating good work to praise and inefficient work to remedy defects.
(10) Build always on a firm foundation. Have a positive knowledge of each task.

---

* Presented before the South of Scotland Section of the Textile Institute, November 11, 1921.

Need for Understanding Men

Men who know how to get the maximum results out of machines are common; the power to encourage the maximum from subordinates is a much rarer possession. But when we deal with men we are confronted with a complex problem. Even when we have made a study of psychology, or the laws governing mentality, we have in each individual to deal with his temperament and his personality. Executives should seek every opportunity to study mankind in general, and in particular the men under them.

It is one of the main functions of the executive to discover the aptitudes of each individual under his care, and see that he obtains a certain versatility in the duties given to him which will bring out his aptitudes. At any rate, these aptitudes must be discovered and developed. We cannot afford the economic loss due to wasted man power. It is not fair to the man, the business, or the country. In a sense, he has a right to look to you to help him to discover himself. Each worker must be happy. You must understand his weaknesses, and watch out for the trouble he may cause. Encourage his good points, and deal with his faults. The whole essence of the art of management lies in the proper understanding and proper dealing with men.

Allocation of Functions in the Subordinate Positions

Having sized up the organization at your command, your best step will be to consider the functions for which you are responsible. Where an executive occupies a position which is subordinate to that of the head of the branch, then his next step will be to confer with his head and obtain a clear understanding as to the particular functions for which he will be held responsible.

He will then be in a position to allocate such functions to himself and to his subordinates in accordance with the organization under his control. In this allocation of functions and duties you should bear in mind the following points:—

(1) Avoid the undue concentration of duties or authority at any one point.

(2) Have in mind the average man who will have to carry out these duties, and do not put on too great a load for the average man to carry.

(3) Arrange for the hardest tasks to be taken care of as well as the easiest.

(4) Make it possible for duties to be performed in a way that will yield the greatest returns in the shortest time.

(5) Each sub-section, group, or branch should be so arranged as to contain all the factors which will affect the performance of its particular functions. Only in this way can each subordinate be held strictly responsible for the successful accomplishment of the tasks allocated to him. In addition, this greatly reduces the amount of supervision required, and also tends to develop and strengthen the subordinates.

(6) Allocate the functions so that you are in a position to deal with any task in its elementary parts rather than in large units.

Delegation of Authority

By preparing very carefully the foundation of the organization, personnel, etc., you have a clear course as to how much is to be delegated, who would carry the load for you, how this would be carried out, the points at which you can check up accomplishment, and so direct the energies of your subordinates. In delegating authority, endeavor to keep your subordinates as far as possible on the highest kind of work of which they are capable.

In giving orders or instructions, see that you [illegible] them, giving the reason for which the work has to be carried out, so that you arouse interest in the worker and give him ground for self-respect in accomplishing the task. Encourage him to take pleasure from his work, as it gives him an outlet for his energies and an opportunity to demonstrate his mastery over the task.

Naturally, you will have an objective in all your plans. Let your subordinates know what your objective is. See that the juniors get versatility in the tasks which are handed out to them, so that they may broaden their experience in the department's work. The evolution from the junior to the executive is that he should "first learn something of everything, and then learn everything about one thing."

Develop the habit of letting go your detail work. Occasionally, have a sort of "spring cleaning" with regard to your daily work; ask yourself why you are doing certain tasks and if there is anyone among your subordinates who could be trusted with it. Remember that you are expected to keep the reins in your hands. You have authority over your subordinates, and in final analysis must take the responsibility for the work with which you entrust them. See always that you keep at least 1 per cent. of anything that you depute in your own hands. Remember that work is most easily controlled at its origin and checked at the pivotal points or at completion.

Orders or instructions communicate authority from you to those under your charge. Reports on accomplishment discharge the responsibility of a subordinate to you. Arrange for information to come through automatically, rather than as a result of your own personal effort in collecting it. Don't let work drift along at the comfortable level of the average mind.

The principle that authority and responsibility should coincide is often lost sight of. Responsibility cannot be developed in individuals unless they are given specific authority. Obviously, responsibility for good or bad accomplishment cannot be fixed unless the authority be clearly defined and responsibility made to coincide. Inability to fix responsibility clearly and justly for acts that have already taken place is without doubt one of the greatest enemies of organization.

Train, Direct and Supervise

A point is ultimately reached in the expansion of any business when the personal relations that existed between the master and the man no longer obtain, and these must be replaced by organized effort. Business men are fast waking to the fact that the greatest problem that confronts them is the man problem. This has been brought home more forcibly in recent times because:

(1) We are passing from an industrial period where the greatest economies have been effected by labor-saving devices to one where human ingenuity is necessarily devoted to a finer organization of business.

(2) We are realizing that mechanical invention economies cannot proceed indefinitely, nor can the utmost values be obtained therefrom without dealing with the human factor in whose hands the economies are really effected.

(3) We realize that an organization is an organism pulsating with energy that needs direction.

(4) We appreciate the principle that man is the cause of which all else in industry is an effect, and that the success of any business is no greater than the sum of the successes of the people in it.

(5) Investigation has proved our general ignorance of the content and potentiality of the human factor.

(6) We find too great a turnover of workers, much of which is due to our lack of appreciation of the versatility of human talents, to the lack of adequate training and proper employment plans.

(7) Or the great upheaval brought about by the war and its attendant circumstances.

(8) Much of the present unrest, in final analysis, is due largely to the [illegible] adjustment incident to subordinating one

human will to another, especially when it is accompanied by work conditions which tend to repress the development of the human personality.

Executives are continually complaining of the meagre equipment and indifferent attitude of the juvenile recruits towards work, and the consequent large turnover and instability of workers, resulting in a serious lack of highly skilled workers and a shortage of competent men for the posts of full responsibility. To-day, industry must not bear the cost of human depreciation but assist in preventing it. We must, therefore, create the best possible work environment for discovering and training human aptitudes.

Industry is continually looking for ability. Industrial training, vocational guidance, and scientific management are but successive phases of the same problem—which is to make every member of the organization an efficient industrial and social unit. The problem, then, is to develop the man, and the supreme function that of the conservation of human energy.

Training the Worker

This question of training is but a part of the larger question of vocational guidance, which implies the proper selection of employees and the training and application of their talents. It forces us to comprehend the physical, intellectual, and moral worth of each worker. It calls for readjustments in education and work opportunities that will establish, maintain, advance and defend individual freedom, and thus enable a man to make the most of himself. Work environment profoundly affects the welfare of all people. Work is the chief training school of life. Training is the means by which fitness is most quickly and easily acquired.

Vocational guidance should be, as far as possible, a matter of self-direction, through the creation constantly by the executive of the right kind of opportunities. Workers are entitled to direction and training in addition to their weekly wages. Each individual, as he proceeds through life, has continually to be making choices as to the best direction in which to apply his energies. He needs health, income, progress, sociability and opportunity for wholesome constructive leisure, and in these democratic days it is all-important that he should have his sense of justice satisfied.

The significant influence of the rise of the human factor in business relations is seen in many directions:

(1) In the distracted and torn conditions in which society finds itself today.

(2) In the conflicts between Capital and Labor.

(3) In the dissatisfaction among business men with our educational output.

(4) In the discontent in the educational sphere with what industry has to offer to the workers.

(5) In the grave criticisms coming from without, because of the social burdens forced upon society by the unemployed—created in large part because they were first misemployed, then under-employed, then unemployed, and finally made unemployable.

(6) At the same time the increase of wealth, the spread of all forms of education, the growth of political democracy, and expanded freedom in many directions have vastly enlarged the horizon of the worker.

Objects of Training

In training the men under your control, you should bear in mind constantly that you have to develop heads as well as hands. Routine workers must perforce have to deal with tasks which are beneath them in quality, but you must show how, by intelligent thought, even routine work can be made a problem of method. Encourage each worker to entertain a just respect for his work. Keep accurate records of performances by workers. Familiarize each worker with the qualities which you consider ideal for his job; then inspire him to strive for their development and attainment. Study each worker in relation to his task, and find out the causes of his success or failure. Praise the former, and give constructive criticism with regard to the latter. You must help the worker to think, to be orderly and logical in his process of thought, to be accurate in his observations and discriminating in judgment.

Set ideals for your staff. Develop departmental pride, but let it conform to the ideals of the business. Get some soul into the work and develop team work. Awaken the consciousness of service whereby each realizes that all good work satisfies the wants of others.

Let there be an observance of the spirit as well as the letter of the rules which govern business relationships. Encourage each person to think, feel and work on the positive side of life. The future and not the past is always the banner to float before aspiring workers.

Opportunities for the worker must be created. See that workers are not overlooked or overworked. Make it possible that there shall be nothing between a man and success except himself. Make sure that the man most capable and efficient in a certain kind of work will get that work to do. Development of character is most important so that each worker may the better be able to engineer his life to greater happiness.

Direction and Supervision

The executive must fill his own position properly before he can expect to have the substance of authority rather than the mere shadow which his position gives him. Real authority comes in a large measure from actual knowledge of the functions, activities, duties and tasks over which the executive exercises control. The big work for executives is not that which has to do with factories, plant, manufacturing, figuring, or merchandising, but that of man-building.

You will get bigger returns for the time and effort spent in developing your workers than the same time and effort spent on the inanimate things of business. Take up the study of man, and commence with yourself. Train yourself to get down to the level of each individual under you. Start from his viewpoint, and, working from this, bring him round to the business viewpoint, which, on right foundations, should mean finally the best interests of the man himself. The object of all training should be to increase the usefulness of the worker—usefulness to himself and others.

Functions of Management

Some executives work incredibly hard, live a strenuous life, and never have a minute to themselves. Time and energy are dissipated over little things. Such an executive is continually answering the demands of a disorganized business. He is at the beck and call of everyone with whom he deals, each supplied with a weapon of the executive's own forging, which is being used against himself. This is one of the most harassing positions in which an executive can find himself.

The true executive is gauged by his ability to control, judge, plan and execute. Sound judgments and correct decisions are the keynotes of the test. The executive's job is primarily a thinking job; he is dealing with forces rather than with things or systems. The business man of small calibre knows little or nothing of these fundamental forces. Business is becoming increasingly more exact, more scientific, and therefore more professional. I have endeavored to show that organization and management can be based on laws and principles, causes and effects. Business management is a profession.

Extraordinary as it may seem, business is the only profession that a man can enter without previously preparing himself for it. A man cannot become a doctor, a lawer—he cannot even become a stonemason or a carpenter—without previous preparation. But he can slip into business no matter how inadequately prepared he may be in the science of business. Real executive power will not just come to a man—he must study and train himself for the position.

Administration is a "thinking" job. The true executives of tomorrow and of the future are going to direct more and more on the basis of scientific knowledge rather than on the basis of tradition or precedent.

Artificial Aluminous Abrasives

IN the processes commonly used for the manufacture of artificial aluminous abrasives the raw material is bauxite, and occasionally natural emery. The bauxite is first calcined to remove the combined water and then mixed with sufficient coke to reduce the iron and silicon oxides in later fusion in the electric furnace. By this procedure titanium dioxide and iron oxide are only partially removed.

Prolongation of the furnace fusion or addition to the mixture of a larger excess of coke in an endeavor to reduce the oxides of titanium and iron, results in the formation of reduction products of alumina and the rapid disintegration of the fused material on exposure to the atmosphere, the material as a consequence being quite useless as an abrasive. Treatment of this product after crushing, with sulfuric acid or hydrochloric acid, fails to effect any improvement in the grade of the product, due principally to the fact that the iron and titanium are present inclosed and uniformly distributed in the corundum crystals as amorphous threads or stringers.

Clarence J. Brockbank has discovered that by roasting the bauxite or emery with alkali carbonate or other alkaline compounds, prior to the electrical smelting process, the oxides of iron and titanium, although not reduced to any greater extent during the processing in the electrical furnace, are nevertheless segregated as a crystalline compound between the crystals of corundum.* He finds that these oxides are changed from an insoluble form to a form soluble in dilute sulfuric acid, and therefore, can be substantially removed from the material by crushing the latter to a powder and digesting it in a solution containing sulfuric acid for such period of time as may be necessary. It is probable that the alkali combines with the silica and some alumina to form a fusible silicate in which the iron and titanium oxides dissolve at the high temperatures, and from which silicate they crystallize out as soluble oxides as the temperature falls.

Procedure

To a bauxite having the following composition:

	Per Cent.
Silica	[illegible]
Iron oxide	[illegible]
Titanium dioxide	4.0
Al_2O_3	54.8
H_2O combined	30.5
	100.0

Mr. Brockbank adds sodium or potassium carbonate in the approximate proportion of 50 lbs. to each ton of ore, the resulting mixture being then roasted in a rotary calciner to a temperature of approximately 1100° C., which is sufficient to remove the combined water.

During this roasting process, the alkali combines with the metallic oxides and the silica, forming easily fusible silicates. The ore from the calciner is then mixed with sufficient coke to effect reduction of [illegible] and iron, due allowance being made for the effect of the carbon electrodes, and the mixture fused in an electric furnace. For the above described bauxite, coke in the proportion of approximately 22 lbs. to 400 lbs. of the calcined bauxite will be found sufficient for reduction purposes.

After fusion, the pig or ingot of fused material is broken down, crushed by rolls to powder and then treated with a solution of sulfuric acid in the following manner:

The crushed grains are placed in a lead lined wooden tank or other suitable receptacle, and sufficient of a 10-percent solution of sulfuric acid added to cover completely the mass. Heat is applied by means of a lead steam coil, and the treatment continued for approximately 6 hours, when the material is washed and graded to different sizes of grains.

When grains prepared and treated in this manner are mixed with ceramic bonds and vitrified in a pottery kiln, articles may be produced very pale yellow in color instead of dark brown as heretofore, more homogeneous in texture, and consequently greatly superior not only in appearance but in cutting and grinding qualities.

---

* [illegible]

American Artificial Silk Industry

From a reliably estimated world production of 26,000,000 pounds in 1914, American-produced artificial silk in 1921 aggregated 20,000,000 pounds, double the output of the previous year.

The Viscose Co., with plants at Marcus Hook, Pa., Roanoke, Va., Lewistown, Pa., produces the larger part of American artificial silk. Its output increased from 9,000,000 pounds in 1920 to 18,000,000 pounds in 1921. Plans are under way to increase its production capacity to 28,000,000 pounds. To lessen its dependence upon wood pulp as a cellulosic raw material, the Viscose Co. acquired Area E of the former munitions plant at Nitro, W. Va., comprising 52 acres and three pulp mills for producing pure cellulose from cotton linters.

The DuPont Fibre Silk Co., Inc., started production in July, 1921, at its plant near Buffalo, N. Y., planned for an annual output of 1,500,000 pounds, which it attained by the end of the year, having reached a production of 100,000 to 120,000 pounds per month.

The Tubize Artificial Silk Co. of America, at its Hopewell, Va., plant produced 845,000 pounds during the last six months of 1921.

The National Artificial Silk Co., and the Industrial Fibre Co., with plants at Cleveland, Ohio, the Lustron Co., Boston, Mass., American Cellulose & Chemical Mfg. Co., Ltd., 681 Fifth Avenue, New York, with plant at Cumberland, Md., Cellulose Silk Company of America, Chester, Pa., American Fibre Products Co., Hawthorne, N. J., and a plant at Paterson, N. J., established by R. P. [illegible], 19 North Moore St., New York, comprise additional concerns active in artificial silk manufacture.

Camphor Substitutes in Plastics Manufacture

A FACTOR of great importance in the manufacture of pyroxylin plastics is the substance used as the softening or conditioning agent for the cellulose ester. Although the patent literature discloses a very large number of substances as substitutes for camphor, only a small number have found practical application. Only a few of these substances show any superiority over camphor, and in these cases the difference is usually insufficient to make up for their much higher cost. About the only one at present available in this country is triphenylphosphate which is employed to a limited extent in the nitrocellulose plastics industry, and then only in connection with camphor.

The scarcity and high cost of camphor has led Johannes M. Kessler, of West Orange, N. J., to investigate the suitability of various substances as camphor substitutes which have not heretofore been suggested for this purpose; as a result of this investigation he discovered that cellulose ester sheets and films having excellent physical and chemical properties from the standpoint of their use in the arts may be obtained by using as a softener any one of several classes of substances which may be produced from available raw materials at a reasonably low cost.

A class of substances which Mr. Kessler found to be suitable as camphor substitutes and which, in combination with a cellulose ester he has patented,[*] comprises the esters of acyloxy-carbocyclic acids, as for example the alkyl or aryl esters of acyloxybenzoic or acyloxynaphthoic acids. Of this class of substances the species which are most readily obtainable are the salicylic acid derivatives, and particularly the acetyl and benzoyl derivatives of the methyl, ethyl, and butyl salicylates.

Some of the valuable properties which these acetylsalicylates have are non-volatility at ordinary working temperatures, high stability and practical insolubility in water. The very pronounced odor of the non-acetylated esters of salicylic acid and the discoloration produced in transparent or delicately colored cellulose ester compounds containing them, make their application as solvents for pyroxylin prohibitive.

By introducing an acyl group such as an acetyl group in place of the free hydroxyl group of these compounds, the objectionable features just mentioned are overcome, and the colloiding power is increased at the same time, as has been proved by numerous tests. Compositions containing nitrocellulose or cellulose acetate and any one of these acetylated salicylic acid esters and produced by the same well known process that is in use for the manufacture of cellulose nitrate plastics, such as pyralin, celluloid, etc., give highly satisfactory results when tested for stability to light and heat, flexibility, moldability and tensile strength.

Mode of Preparation

In general the methods which may be used in preparing some of the new camphor substitutes are as follows:—

The methyl acetyl-salicylate, also known in pharmacy as methyl aspirin, may be prepared by the acetylation with acetic anhydride of commercial methyl salicylate. In order to obtain the next higher homologue, ethyl salicylate was prepared by the esterification of an ethyl alcohol solution of salicylic acid with gaseous hydrochloric acid as catalyzer and afterwards acetylated in the usual way. Butyl acetyl salicylate was obtained in a similar manner by using butyl alcohol in place of the ethyl alcohol. All these materials were finally refined by rectification in vacuo. The methyl derivative is a solid with a melting point of 49-50° C. while the ethyl and butyl compounds are liquids at ordinary temperatures.

The mode of preparing the new cellulose ester compositions may be illustrated by the following examples:

I. 100 parts of pyroxylin, preferably anhydrous, are kneaded with 30 parts of methyl acetyl salicylate and 72 parts of denatured alcohol at a temperature of 40-55° C. until the nitrocellulose is properly colloided; after which it is put on rolls and through the different operations such as rolling, cake-pressing, sheeting and seasoning which are well known in the manufacture of cellulose nitrate plastics such as pyralin, celluloid, etc. Suitable amounts of stabilizer, for example, urea, and of pigments and colors may be added either during the mixing or the rolling operation.

II. Instead of 100 parts as specified in the above example, more or less of the pyroxylin may be used, as for example, 90 parts or 105 parts. If a certain amount of camphor is used the amount of acetyl-salicylate for proper colloiding may of course be correspondingly decreased. A part of the acylsalicylate may be substituted by other softeners such as triphenylphosphate.

III. For producing an inflammable substitute for transparent nitrocellulose plastics (films, etc.) the following composition is particularly suitable:

Cellulose acetate	75.	parts.
Triphenyl phosphate	9.	"
Urea	0.75	"
Methyl acetyl-salicylate	15.25	"

The colloiding of the cellulose acetate may be carried out in the same manner as described in Example I.

Liquid coating compositions may be made by using larger amounts of solvents than specified in Example I. Suitable solvents are acetone, or methyl alcohol mixed with ethyl acetate and amyl acetate, or a mixture of acetone and methyl alcohol.

As examples of other acylsalicylates which may be suitable as softeners according to Mr. Kessler's invention, there may be mentioned:

Phenyl acetylsalicylate (M. Pt. 98° C.)
Alpha naphthyl acetylsalicylate (M. Pt. 91° C.)
Beta naphthyl acetylsalicylate (M. Pt. 136° C.)

The above mentioned methyl acetylsalicylate has a melting point of 49° C., and the ethyl ester a boiling point of 272° C.

Instead of the acetyl derivatives of the hydroxycarbocyclic acid esters, the formyl, propionyl, or benzoyl derivatives may be used, although as a rule these latter have no advantages over the acetyl derivatives, and are more expensive.

Sheets of Mr. Kessler's new composition are easily made by cutting a slab of the plastic mass produced as in Example I; or if desired a viscous solution is prepared by using a larger amount of solvent, and the solution flowed to form a sheet or film.

E. G. Rippel has resigned as sales manager, Buffalo Foundry & Machine Co., Buffalo, N. Y., after 21 years' service during which the company attained preeminence in the manufacture of chemical equipment. He is succeeded by C. W. Pearson, formerly assistant treasurer.

---

[*] U. S. Letters Patent No. 1,408,075, issued Feb. 28, 1922, assigned to E. I. du Pont de Armours & Co.

Some Factors Affecting the Products of the Destructive Distillation of Oil Shales

By Lewis C. Karrick
Associate Oil-Shale Technologist, U. S. Bureau of Mines

IN studying the destructive distillation or pyrolysis of oil shales, the primary consideration is to determine the effects of heat on the organic components of the shale. The impracticability of separating these organic components, collectively known as "kerogen," from the mineral matter with which they are associated renders the problem extremely complex.

The behavior of the kerogen in the shale while undergoing the heating process is probably different from that of the same kerogen if it could be isolated and treated under similar temperature conditions. In fact the results of actual distillations have shown that the physical properties of the mineral matter in the shale may be the cause of much variation in the products of retorting.*

Structure of Oil Shale

It must be remembered that the inorganic material of the shale is a heterogeneous mixture of minerals solidified into a very close-grained compact mass. This mineral mass has a thermal conductivity different from that of the kerogen, thus complicating the problem of even distribution of heat. Furthermore, the temperatures of dehydration of gypsum and some hydrous silicates are included within the temperature range of the shale distillation. These minerals are frequently present in the shales, and the evolution of water vapors from them will affect the partial pressures of the hydrocarbon vapors evolved from the kerogen, probably tending toward the improvement of the quality of the oil distillates. Carbonates and sulphides which also are frequently present begin to decompose within this range of temperature, and the gases produced from them may alter the chemical constitution of the oils produced from the kerogen.

The spent surface layer of a distilling lump of oil shale may be penetrated only with difficulty by the escaping oil vapors as they work their way from the inside of the lump, and pressures may thus develop within the shale itself. The oil vapors therefore, will escape at higher temperatures than are necessary for their formation, a condition conducive to unregulated decomposition of the oil. These are only a few of the possible effects on the products of the kerogen that may be caused by the properties of the mineral matter of the shales. Consequently it is very difficult to predict results when new and unfamiliar shales are being destructively distilled.

Experimental Methods of Bureau of Mines

The individual problems of the retorting of oil shales, therefore, must be solved largely by "cut and try" methods. In the research work of the Bureau of Mines, oil shales are treated in various states of fineness and under many conditions in which the temperature, time and rate and methods of supplying heat are varied. The atmosphere surrounding the shale while it is distilling, is made to contain definite proportions of certain [illegible] and vapors which are tried for their possible chemical influences on the oils produced and also as sweeping mediums. The gases and oil evolved during distillation are collected and analyzed, and their properties are tabulated against the known conditions under which they were produced. Thus the data pertaining to any one shale can be correlated and made available for use in the design of suitable retorts wherein known principles of chemistry, thermodynamics and engineering practice may be employed.

Properties of Oil Shale Treatment Responsible for Variation in Derived Oils

Many products composed of hydrocarbons and their derivatives can be obtained by the destructive distillation of kerogen. The character and quantity of the substances produced depend greatly upon the temperature to which the vapors produced from the kerogen are heated within the retort, and upon the presence or absence of materials which catalyze the cracking of the primary decomposition products. The length of time that the vapors remain in the retort seems also to have a decided action on the vapors and products subsequently recovered. It does not follow, however, that all shales will yield the same products when heated under similar conditions, because shales differ physically and chemically, and the oil-forming material may be of an entirely different origin in different shales.

The organic matter of the oil shales of the eastern part of the United States, occurring in the Devonian formations, is made up almost entirely of spore matter. This is also true of some of the Scotch shales. The western shales, of the Green River formation, seem to be more complex and contain, in addition to the spore matter, resinic and cellulosic materials. Some of the cannel coals and cannel slates of the east also belong to this latter class. These various shales give different oils under the same retorting conditions, a fact which has much experimental support. However, it has not yet been determined completely how much of the dissimilarity in the oils evolved is due to the character of the included organic materials, or how greatly the amount and character of the minerals associated with the organic matter may affect the oils.

Influence of Physical Structures of Shale on Distillation Products

It is quite probable that in all shale-retorting methods the actual decomposition of the organic matter of the shale begins at comparatively low temperature, usually from 250° to 400° C. The ultimate products produced, however, owe their characteristics very largely to the chemical and physical reactions that occur while the primary product, which is probably a viscous liquid, is passing into the vapor state, or to changes while in the vapor phase. These reactions and changes will be influenced largely by some of the causes mentioned above, and also by characteristics of the retort design.

The first effect of heat upon the shale is the removal of some of the occluded gases that exist in very small quantities. Next, actual decomposition or change of state of the kerogen probably commences, wherein a heavy liquid soluble in organic solvents evidently forms.* Third, as this heavy liquid forms it decom-

---

*[illegible] M[illegible]

*[illegible] is taken from [illegible] Shales" by R. H. McKee, [illegible] Chem., vol. 15, Aug., 1923, pp. [illegible] of Bureau of Mines investigations.

Airplane view of East Middle Fork of Parachute Creek, north of Grand Valley, Colorado, which enables one to visualize the splendor of the Colorado scenery and the vast extent of the raw material of the prospective chemical industry of oil shale products. Coupled with the magnitude of its resources, however, are their present inaccessibility and remoteness from the great consuming markets via rail haul. The development of these resources is only a question of time and chemical engineering ingenuity. Photograph is of the holdings of the Gary Shale Oil & Refining Company, 427 U. S. National Bank Building, Denver, Colorado.

poses at a temperature which may be affected to some extent, as has been stated, by pressures developed within the pieces of shale. Finally, as the vapors are produced within the pieces of shale, they immediately become subject to pyrolysis caused by their passing through zones of higher temperatures before they escape from the retort. The vapors are certain to become somewhat superheated because, having low specific heats, they will readily absorb heat from the hotter shale with which they come in contact.

The vapors on passing outwardly from the center of a lump of shale will move in a direction opposite to the flow of heat, and will obviously become hotter as they pass outwardly through the lump, since the lump is transmitting heat inwardly. Consider, for instance, that a piece of oil shale the size and shape of a brick, is being heated and that the heat is being supplied equally to all portions of one of the larger faces. When the temperature of oil production is reached, assuming there is no side radiation, this entire face, being the first part to reach distillation temperature, starts distilling simultaneously. If the temperature of heat supply were not increased, the distillation on the heated surface would soon become negligible although only a portion of the total possible oil had been produced from the kerogen on the surface. However, the distilling zone would work back through the shale as the heat penetrated until the entire mass had reached about the same initial degree of decomposition. A rise of temperature would then renew the evolution of oil vapors, beginning again first at the surface and then working inwardly. However, the final oil would not be produced until the temperature reached approximately 500° C. throughout, or about 100° to 250° C. above the temperature of first oil production.

The fact that the vapors may become superheated and somewhat decomposed is not wholly undesirable. If there were no dissociation of vapors taking place within the retort, it would be logical to expect that a substance would be produced having very little similarity to commercial oil and which would require subsequent cracking treatment before being suitable for the ordinary uses of petroleum. But it is possible to vary within certain limits the degree of dissociation within the retort by taking advantage of cracking and catalytic influences, thereby obtaining products more nearly resembling petroleum.

Effect of Temperature Lag

Commercial considerations will probably require that the shale be heated fairly rapidly and that the heat be supplied increasingly so as to obtain the maximum tonnage throughout per retort. Given these requirements, the temperature difference between the outside and inside of the shale lumps will become increasingly greater as the treatment progresses until a fairly constant difference obtains, depending both on the rate of rise of temperature and upon the thermal properties and heat consuming reactions of the shale. In other words, the temperature difference for a given depth of heat penetration will depend upon the temperature of the heat source, the thermal conductivity and specific heat of the shale, the heat consuming reactions, and the amount of heat carried away by the escaping vapors and gases.

It is obvious then that there is likely to be a wide range of temperature when heating rapidly, not only within the shale pieces themselves but also within the shale charge as a unit, unless it is in some manner agitated.

In order to obtain experimental evidence in regard to the magnitude of the temperature lag that may be expected during retorting, retorting tests on samples of shale ground to pass a quarter-inch screen have been performed, temperatures being measured at the hot surface and at a point within the charge two inches from the hot surface. The temperature of the heat supply was increased uniformly and arrangement was made to withdraw the vapors in the direction of the flow of heat. The rate at which heat was supplied was such that three hours elapsed during the entire heating process, or one and one-half hours from the time the first oil vapors evolved till the shale was entirely spent. When the outside, or hottest part of the charge was beginning to distill at 365° C., the interior point of lowest temperature had reached 100° C.; when the outside had finished distillation the inside point was only at 265° C., and finally when the inside was nearing its final oil-producing stage at 520° C., the outside had reached 725° C.

Had lumps of shale four inches in diameter been heated similarly, oil vapors liberated at the center, on working to the surface would have passed through a layer of partially spent shale two inches thick and would have been subject to a temperature as much as 250 degrees above that at which the vapors were produced. It is, therefore, probable that the superheat received by the vapors in penetrating the hot exterior zone will alone greatly decompose them, but there are other factors working simultaneously to augment the cracking. Some of these factors are the finely divided or capillary condition of the vapor streams in passing through the porous spent shale layers, the pressure under which the vapors must be while forcing their way out of the shale lumps, and the catalytic influence of the spent shale.

Commercial considerations prevent the employment of extremely long retorting periods, which might largely remove some of the difficulties outlined in the preceding paragraphs. However, fine grinding of the shale will accomplish very similar results, since the depth that heat must penetrate in the individual particle will be negligible. The kerogen will be largely freed by fine grinding and the pyrolysis will become practically a surface reaction. This expedient has its commercial objections also, but for research it offers possibilities by eliminating many of the difficulties of studying the fundamental properties of the kerogen.

Effect of Rate of Heat Supply

If the shale is heated very gradually the vapors and gases evolve very slowly, and unless means are provided for scavenging they will tend to stagnate within the retort and are thus subjected to prolonged pyrolytic effects which may result in excessive decomposition. It must be borne in mind, however, that the vapors are produced by destructive distillation and if distillation is hastened by excessively rapid heating the retort temperature may be so high that the vapors will be badly decomposed even though they are removed quickly. Commercial retorts must, therefore, be designed to effect a compromise governed by economic considerations.

In the well known Scotch shale retort lumps of shale averaging the size of a building brick are used, and consequently the shale is allowed eight hours in which to complete distillation. An atmosphere of steam serves to equalize the temperature throughout the retort, with the result that each lump is heated equally on all faces. Under this condition of slow rate of heating and slow production of vapors, very even temperatures exist within the shale, with the result that the amount of superheating is relatively small. However, there would be ample time for much undesirable decomposition of the vapors were it not for the fact that a great volume of steam is passed through the retort as a scavenging medium and also for its beneficial chemical effect on the oil produced.

If the shale is retorted at an extremely rapid rate, the destructive results which characterize the high temperature coking of coals are approached wherein nearly all the oil vapors are decomposed to gas, tar and carbon. It may be expected, therefore, that a retort whether horizontal, inclined or vertical which exposes to the vapors a large, excessively heated surface, will, unless it uses an efficient scavenging medium, probably produce much gas, much carbon, and inferior oil in relatively small quantities.

Safe Practice in Handling Sulphuric Acid

By Donald S. Grenfell

New Jersey Zinc Co., Palmerton, Penna.

The writer wishes to offer an addition to the interesting article by M. F. Crass in the November, 1921, issue of Chemical Age on "Safe Practice in Handling Sulphuric Acid."

Those who have unloaded tank cars of acid by air pressure will have noticed the vibration which occurs near the completion of the unloading operation when the car is almost empty. The reason is that, with the full air pressure and acid valve openings, the acid does not drain to the sump fast enough to keep the discharge line filled with acid with the result that alternate slugs of acid and air pass out the acid line. Unless this is well anchored, the vibration is severe enough to break the line at some weakened point in the threads with disastrous consequences that readily will be appreciated.

To lessen this danger, the acid lines should first be anchored firmly and be as free from angles and bends as possible. There should be a valve between the discharge line and the tank car proper. The acid flow should be throttled down by the operator as soon as his ear detects the first vibration caused by the air entering the discharge line. The air valve may at the same time be closed as there is a sufficient amount of air under pressure in the car to complete the unloading under ordinary conditions.

By the observance of the above precautions, the danger will be minimized and the vibrational strain on the piping lessened considerably.

American Medical Products, Inc., 543 Broadway, New York, at its first annual meeting February 27, reported satisfactory results of its first year's activities and elected the following officers: President, Charles H. Huhn; Vice-pres.-Sec., Thomas H. Potts; Treas., Farquhar J. MacRae, C. P. A.; General Manager, Joseph C. Tolman.

The board of directors comprises: Charles H. Huhn, Minneapolis, Minn.; Thomas H. Potts, Farquhar J. MacRae and Joseph C. Tolman, New York, N. Y.; John J. Possehl, Milwaukee, Wis.; Percy M. Davis, Scranton, Pa.; Dr. Frank H. Newton, Toledo, O.; Marion A. Stout, Bluffton, Ind.; William A. Abbett, Duluth, Minn.

Professorial Salaries

A Study of Their Increase and a Basis of Comparison.

By John J. Tigert
U. S. Bureau of Education

A GLANCE at magazine articles appearing in the two decades just previous to the World War shows a uniform tone in those touching upon the subject of salaries in colleges and universities. The overwhelming majority of these articles imply that professorial pay was totally inadequate. An editorial in the *Nation*, December, 1903, undertook to show that college salaries were insufficient to keep the strongest men in the colleges but maintained that a reasonable increase would suffice to hold them because they did not demand luxuries and enjoyed other compensations in addition to the remuneration. This editorial is fairly typical.

Many of the articles imply further a certain lack of public esteem for the professorial calling. George Trumbull Ladd, in the *Forum* in 1902, writes of the "degradation of the professorial office." An article in the *Atlantic Monthly* in May, 1905, set out a list of thirty-one necessary items of expense for a professor with a family and from these the author undertook to show the inadequacy of salaries at that time and the necessity for improvement.

Going back a little further, we find that, in September, 1893, nearly thirty years ago, a writer in the *Forum* gave a statistical review of professors' salaries in 124 American colleges. The author contended that the American professor had too many responsibilities, that too many demands were made upon him and that he required an average salary of $2,000 rather than $1,400 per year as he was receiving at that time. A surprising number of the articles make comparisons between conditions in the United States and Germany which one would hardly dare make today for fear of the charge of pro-Germanism.

An exceptional writer, here and there, expressed the conviction that salaries were quite adequate and voiced the unusual opinion that the salaries were determined by principles of economics and that every man received what he was worth. For example, under the caption "Confessions of an Obscure Teacher," a writer in the *Atlantic Monthly*, September, 1906, took the very surprising and optimistic view that his salary of a little less than $2,000 was quite sufficient for all his needs. Nevertheless, as we have said, the prevailing feeling all through the years has been that professorial salaries are inadequate. We think that is still the consensus of opinion.

The following figures compiled by the Chief Clerk in the Bureau of Education and published in Bulletin 1920, No. 20, offer some comparisons between the remuneration of college professors and other workers:

Teachers in Universities and Colleges	Average Salary, 1919	Employees in Mechanical Industries	Yearly Earnings, 1919
Public:		Structural ironworkers...	$2,379
Professors	[illegible]	Carpenters	[illegible]
Associate professors....	2.514	Painters	2.078
Assistant professors....	2,053	Road train [illegible]	[illegible]
Instructors	1,552	Machinists	1,777
Private:		Hod carriers	[illegible]
Professors	[illegible]	Railroad yard employees	[illegible]
Associate professors....	2,423	Hostlers and engine-house men	[illegible]
Assistant professors....	1,770		
Instructors	1,205		

It will be seen that, in 1919, associate professors were slightly better paid than structural iron-workers who were better paid than professors in private institutions; that carpenters and painters were paid about the same as assistant professors in state institutions, but much better paid than assistant professors in private institutions; that machinists were paid about the same as assistant professors in private institutions; that instructors in state institutions received less than hod carriers and about the same pay as railroad yard employees, while instructors in private institutions were paid almost to the dollar the same as hostlers and enginehouse men.

The U. S. Bureau of Education gathers statistics annually with reference to salaries in state universities and colleges. Some comparisons of pre-war and present salaries may be illuminating and interesting.

Salaries of College Presidents

In the collegiate year 1913-14, just previous to the outbreak of the war in Europe, the average salary of the presidents of the state institutions was $5,249. In 1919-20, the average salary of the same men had risen to $6,663, an increase of 26.9 per cent. In neither case are allowances made for residence, which were given in addition to salary. However, the number who were given houses were 48 presidents out of 84 reporting in 1913-14 and 57 out of 88 reporting in 1919-20, or an increase of those having residences given them from 57 per cent. to 65 per cent.

In 1921-22, the present year, we asked the presidents to estimate the value of rent of the houses given in addition to the salary and to add it to the salary. In this way, we arrived at an average salary for the current year of $8,861 from 74 reporting. This would be an increase of about 69 per cent. over the average for 1913-14, but no estimate was made of houses in that year. In 1920-21, when no houses were considered, the average president's salary was $7,524 or an increase of 43.3 per cent. over 1913-14.

We would be safe in saying that presidents' salaries in state institutions have risen since 1913-14 up to the present in the neighborhood of about 50 per cent.

Salaries of Faculty Members

The salaries of faculty members rose more rapidly than did the salaries of presidents in the state institutions. This was due probably to the fact that those nearest the margin of greatest need in meeting the greatly increased cost of living were attended to first and presidents came in later for increases. This assumption is fortified by the fact that presidents' salaries rose on the average of only 26.9 per cent. in 1919-20 over 1913-14 but in 1920-21 and 1921-22, they rose 43.3 per cent. and about 50 per cent. respectively over 1913-14.

Thus the increases were relatively much greater in the last two years. Further, presidents' salaries rose in the state institutions 28 per cent. from 1915-16 to 1920-21, which was considerably less than the average in-

---

Our correspondence during the past month with teaching chemists on the subject of salaries obtaining in all departments of individual enterprise having to do with chemistry, which was provoked by an editorial in February CHEMICAL AGE, has resulted in the submission for reproduction in CHEMICAL AGE of the address of John J. Tigert, U. S. Bureau of Education, before the Association of American Colleges, on January 14, 1922.—Editor, CHEMICAL AGE crease for members of the faculty. The salaries of normal school presidents rose from 1916-17 to 1919-20 only 11.8 per cent., whereas all ranks of faculty members were much more favored with increases.

The following figures gathered by the Bureau of Education indicate what has happened in the matter of increases in salaries of the faculties of state universities and colleges between the year 1915-16, the year just previous to the entrance of the United States into the war, and the present collegiate year of 1921-22.

	Average Salary 1915-16	Average Salary 1921-22	Per cent. of Increase
Dean	$3,062	$4,250	38.8
Professor	2,400	3,392	41.3
Associate professor	1,926	2,800	45.4
Assistant professor	1,603	2,300	43.5
Instructor	1,184	1,800	52.0

In citing these figures, it must be noted again, as was the case in computing increases in salaries of presidents, that no allowance was made for houses in 1915-16 whereas houses were taken into consideration in 1921-22. This fact probably makes the estimated increases for deans and to a less extent, for professors a little too high but could hardly affect appreciably those below the rank of professor. But even if the percentages for deans and professors are not too high, the figures show very clearly that the greatest relative increases have come to those in the lower positions who draw the smaller salaries.

Salaries in Normal Schools

In this connection, it might be interesting to call attention to some comparisons between salaries in normal schools and state universities and colleges, which were brought out by Dr. George Zook, the bureau's specialist in higher education, in August, 1920. This study showed that, in the year 1919-20, the average annual salary of professors in normal schools was about equal to the average salary of an assistant professor in a state university or a college and about $250 less than the average salary of a full professor in a privately supported university or college. On the other hand, instructors in normal schools received an average salary of $250 per year more than instructors in private universities and colleges and about $150 less than instructors in state universities and colleges.

Those Leaving the Profession During the War Period

Some will be interested to know what effect did the war period have in alluring men from the professor's chair to other callings, and to what extent those who made the change were benefitted financially. On March 1, 1920, the Bureau of Education listed 121 instances of college and normal school teachers who, in the few years just preceding, left teaching for other occupations. The average teaching salary of the 121 persons who changed occupations was $1,826 and the average salaries or earnings of the same 121 persons in their new occupations was $3,647 or an average increase in earning power of 99.7 per cent. over their old positions as teachers.

It would be exceedingly difficult to find an equal number of persons who went from other vocations into teaching during these years at an average increase of 100 per cent. over previous remuneration, though of course, one sees that the large increase which those leaving the teaching profession received was due in great part to the general rise which was taking place in the period in the remuneration for all professions and all workers of every kind. At any rate, those figures are a good rebuttal to the one who maintains that all wages are fixed by economic laws and that every one gets just what he is worth and no more or less.

Some Comparative Percentages of Increase in Prices and Wages, Since 1913

	1920	1921
Retail food prices	103%	45%
Wholesale food prices	136%	33%
Cost of living	100%	80%
Laborers' weekly wages	130%	——
Artisans' weekly wages	102%	——
Wholesale commodities	143%	51%

These figures, together with those already given on salary increases, reveal conclusively that professorial salaries increased much less during the war period than did the price of food, the cost of living, the wages of artisans or the wages of laborers. The prices of food and the cost of living have fallen considerably in the last two years.

During the war period the college professor, like most salaried persons, suffered tremendously but today he is perhaps in as good a position economically as he was before the war. If he is not, he soon will be because the cost of living will doubtless continue to fall but there is not likely to be much drop in professorial pay.

If the cost of living returns to anything like the prewar level, though it is not likely to go down to the same level except at some distant time, then we may expect that the college professor will ultimately gain from the war because it is hardly conceivable that the present level of salaries in colleges and universities will be forced down very much, in view of the admitted inadequacy of such salaries in the past.

Institute of Chemistry of Great Britain

Alfred Chaston Chapman, president of the Institute of Chemistry of Great Britain, at the 44th annual general meeting held March 1, at which he was reelected president, together with an official staff that embraces the most prominent men in English chemistry, stated that during the year the membership had grown to 3,540, an increase of 371. Student membership aggregates 883, an increase of 84 during the year.

He commented on the fact that, at a time of almost unparalleled industrial depression, less than two per cent. of the members were without employment. He concluded his address, however, with a note of warning. Many parents still retained the impression that chemistry afforded a rapid road, if not to wealth, at least to a comfortable competence and that it involved a less expensive course of preparation than for other professions.

A keen love of the subject was essential to success. Those who were attracted to chemistry should be prepared to face a great deal of hard and often unattractive work, and to make the very real sacrifice which a professional career inevitably involved. The course of training of the average chemical student was of a university character and made the same demands upon the financial resources of parents as those for medicine and the law.

Activity in chemical concerns established by chemists is noted in the announcement by Jayne & Sidebottom, Inc., an independent sprout of the Barrett Co., of their New York and northern New Jersey sales agency of the starch products of the Victor G. Bloede Co., Baltimore, Md., and in the booklet "Standard Chemicals for all Industries," issued by John C. Wiarda & Co., Inc., recently acquired by Howard B. Bishop, formerly of the General Chemical Co.

Butyric Acid as a By-Product of Yeast Manufacture

THE waste liquor or "slop" obtained in the manufacture of yeast and alcohol is proposed as a raw material for the commercial production of butyric acid. This waste liquor comprises water, together with a small amount of glycerol, small quantities of non-yeast-fermentable sugars (pentoses, pentosans, etc.), proteins, simpler nitrogenous substances, mineral salts and lactic and succinic acids.

Production of "Slop"

In the manufacture of yeast, with its correlative product, alcohol, a "mash" is first formed by mixing barley, corn, etc., in suitable mechanical condition, with water at such temperature as is necessary for converting starch into sugar. After saccharification the solid and liquid components are separated, the latter being used for yeast fermentation.

A small quantity of yeast is supplied, and masses of yeast cells are propagated, with the production, as a result of the activity of the yeast organisms in appropriating from the mass those sugar bodies and those parts of the proteins which they can utilize, of a small proportion of alcohol, glycerol, etc. After the culture of the yeast has reached the predetermined point the contents of the yeast vats are centrifuged, yielding the solid yeast components and a liquor containing water, alcohol, fusel oil, aldehydes, etc. This liquor is distilled to separate alcohol and other low-boiling bodies.

The residue of the distillation is the waste liquor referred to above as "slop." While its composition may vary from time to time according to the materials used and the conditions attending the process, the following statement of percentages may be taken as typical of its composition:

	Per Cent.
Water	99.000
Glycerol	.100
Proteins	.375
Non-fermentable sugars	315
Lactic acid; succinic acid (traces)	.200
Mineral salts	.010
	100.000

Utilization of the "Slop"

Frank A. McDermott and Ruth Glasgow have discovered that if this "slop" or residue, left on the separation of alcohol and associated bodies by distillation, is maintained under proper conditions of temperature and closely regulated conditions of acidity and alkalinity, it can be utilized for the production of butyric acid by propagating therein micro-organisms of either of a number of genera, such as *Granulobacter saccharobutyricum, Bacillus subtilis, or Bacillus boocopricus.* None of these organisms will thrive in a medium which is not delicately regulated as to acidity and temperature. If it be strongly acid, as for instance, with the lactic acid which results in the manufacture of yeast, they will not thrive.

The slop as discharged from the distilling apparatus is usually of a temperature of about 98° C., but for the derivation of butyric acid best results are attained at a temperature approaching 90° C. If at this temperature the acid-content be neutralized, or nearly so, with lime, the slop is ready for the introduction of a micro-organism of the proper genus. The organisms for this purpose may be provided from specially formed artificial cultures, but in commercial operations economy demands their development in materials at once plentiful and cheap. For example, malt sprouts may be used for inoculating the slop; if *Bacillus subtilis* is to be used it can be prepared from any of the ordinary varieties of hay.

Conditions of Fermentation

The organisms, say of the *Granulobacter genus,* which McDermott and Glasgow use in their patented process* are sporeformers. These are introduced into the slop when it is at a high temperature, or it is brought to such high heat at any early time after introducing them, and at such heat all of the organisms of the other varieties, such as the non-spore formers, are destroyed. The spores from the organisms of the variety which it is desired to utilize survive, however. After a short period the temperature is lowered to the point where they will germinate and a culture of the organisms can form. These become active, deriving nourishment from the glycerol and from the calcium lactate which has been formed by the neutralizing of the lactic acid with lime, and they also appropriate a considerable portion of the protein and of the non-yeast-fermentable sugars. The micro-organisms utilize these ingredients to supply materials for both cell building and energy and, during the activities in this connection, produce butyric acid in addition to other products.

During this stage of butyric fermentation air should be excluded from the slop; at least air should not be admitted freely into contact with it. This can be accomplished, under ordinary circumstances, by a cover for the top of the vessel holding the slop suitably to exclude the atmosphere.

Products of Fermentation

At the end of the fermentation period the ingredients of the fluid mass comprise: (1) water, (2) calcium butyrate, (3) some free acid, mainly butyric, (4) mineral salts, (5) such residual proteins and other nitrogenous bodies and (6) non-yeast-fermentable sugars as have escaped the action of the organisms, (7) the decomposition products that have been formed by their action upon the initial components above mentioned, together with (8) the cell structures themselves of the organisms which have been propagated during the fermentation.

The mass is still slightly acid at the close of the fermentation period, this being due to small quantities of free butyric, succinic, etc., acids; these being supplemental to the calcium butyrate above described and which is present in relatively large quantities.

Separation of Butyric Acid

From the fluid mass thus obtained the butyric acid is separated. This can be accomplished by (1) concentrating, if necessary, the initial mass; (2) then adding a precipitant, such as copper chloride for example, suitable for forming an insoluble, or approximately insoluble precipitate; (3) the filtering, or otherwise mechanically separating, the compound from the liquor mass; (4) decomposing this compound, by adding a suitable acid; (5) distilling from the mass the butyric acid freed by the decomposition; and collecting the distillate.

In carrying out the process thus indicated the initial liquor obtained from the butyric fermentation is rendered relatively alkaline by adding an active body, or an inactive one, or both, as found necessary, in sufficient quantity; following in this respect the procedure set forth above. Then the mass is concentrated, as precipitation is more effective in a concentrated fluid.

---

*U. S. Letters Patent 1,405,055, issued Jan. 3, 1922, and assigned to The Fleischmann Co.

At this stage the mass is made up of the following components: water, calcium butyrate, proteins, protein decomposition products, sugar, bacterial cells, and some free acid.

The concentrate is now rendered sufficiently acid by adding a mineral acid in sufficient amount to decompose the calcium butyrate.

Then is added an excess of a reagent, such as ferrous sulphate, to precipitate the proteins, the protein decomposition products, and the bacterial cells, etc. This reagent, however, should be neutral as to butyric acid so as not to form a precipitate therewith. After this first precipitant has finished its work the liquid mass is subjected to filtration to separate the liquid from the first precipitate.

To the liquid filtrate is then added cupric chloride in solid form, the mass being preferably stirred at this time, and cupric butyrate is formed. It is but slightly soluble in water, and after the reaction is completed the liquor is again filtered and the liquid is separated from the precipitate.

A strong acid is then added to the precipitate capable of decomposing the butyrate and forming a salt with the copper, the butyric acid being freed by the strong acid.

From the resulting mass the butyric acid is then distilled, use being made of a suitable retort, either by external heating or by means of a current of steam. The collecting and condensing devices may be of any suitable character.

Addition of ferrous sulphate or its equivalent prior to introducing the copper chloride is advantageous as it results in the removal of the proteins before they can act upon the chloride, and the latter body is reserved entirely for acting on the butyric acid. Copper chloride is also a reagent relative to the organic materials of the protein class and much of it would be used up in precipitating them unless they are previously removed.

New Jersey Chemical Society

At the regular monthly meeting of the New Jersey Chemical Society at Stetter's Restaurant, Newark, on March 13, Dr. Clarke E. Davis, of the production department laboratory division of the National Biscuit Co., New York, discussed the functions of shortening and leavening agents in biscuit manufacture and the role of gelatin as a foodstuff and the processes of its manufacture.

Elwood Hendrick, as raconteur, regaled the members with stories of his life and expressed much dissatisfaction with an industrial system that makes possible the chemical manufacturer's fee for brief legal advice to equal the monthly salary of his chemically educated director of production. Mr. Hendrick compared the chemist as regards his usefulness very favorably to the lawyer, but apparently was unable to explain convincingly the situation which so aroused his indignation. He was inclined to feel that it was due to the conventional lawyer's gift of gab and that what the chemist needed today was to work his mouth, unmindful of the fact that capacity in any line is not loquacious but relies for recognition upon results. He got in the target, however, when, with some hesitation, he intimated, that the correction of this situation resides very largely with the chemist. He approached the bull's-eye when he urged chemists to get out among people and to be seen of men and to earn the recognition that comes from service. Here looming above his mental horizon was the sun of applied Christianity in chemistry. Greater than Hendrick have declared that what the world needs is religion.

Mr. Hendrick would have rung the bell, if, with his jovial forcefulness, he had contributed some constructive consideration of the economic status of the chemist along the lines of the following:

Don't complain about the other man's pay and the place he fills in public esteem, but turn your eye inward to see what is the matter with yourself. In the long run men get in this world what they are entitled to. They get back exactly what they hand out. We are governed by natural law and we can bank on its favor if we work with it, but if to native deficiency in its infinitely varying degree, we add the peculiarities incident to highly specialized education in a field overrun with mediocrity and structureless in its disorder, we simply aggravate the conditions pertinent to all.

Other professional men are better paid, as they doubtless are in the higher registers of capacity, because they render a more valued service; or because on these levels competition is not so keen; or because the ability expressed rises from seasoned, logical deductions from the great principles of human experience that may be of great determinative importance to the employer, as with the lawyer, rather than from minds concerned almost entirely with the absorption of the endless facts of the behavior of matter as to which there is much less variation in capacity, as is generally true of the chemist.

Professional men in any line who are deemed successful, primarily are business men; if not they hire men who are, to take care of them. Examples are numerous.

It is the exceptional chemist who is a business man, who grows out of his status as a tool hired by men, who have trained their cupidity, into that of an administrator, which is the professional function of a lawyer. The organizer and late president of the National Biscuit Company was a lawyer.

Chemists and lawyers in their mental processes and in their functions are hardly comparable, regardless of the value of their respective services to society.

Don't encourage chemists in shallow frivolity to complain about the lawyer's pay which, among the common run, is low, but urge them by constructive advice to accept as a precedent the technical relations of lawyers, evolved through centuries in a service that is the stabilizer of civilization.

As stated, Mr. Hendrick would have rung the bell if he had encouraged and commended a group of production chemists in their aspiration to dignify their work by dignifying themselves, as expressed in the creation and conduct of an economic organization of chemically educated men along state lines whereby they seek to ally the arts in whose practice their material salvation lies with the other organized activities of their state in industry and trade, out of which may crystallize capacity in a professional society.

Here is the most potent educative instrument available whereby industrial chemists may acquire professional status.

Seventeen new members were admitted. The next meeting will be April 17th, one week later than the usual date, to permit the attendance of Prof. W. D. Harkins of the University of Chicago, who will address the society on "Isotopes and the Building of Atoms."

W R Whitney

Dr. Willis Rodney Whitney

Director of Research—General Electric Company

"When he completes a research the company declares an extra dividend."

CHEMICAL AGE

Volume 30
Number 3

March
1922

A Consolidation of
The Chemical Engineer
and Chemical Age

EDITORIAL

NO one questions the desirability, in fact the necessity, of the freest and fullest interchange of information among the factors of a particular trade or industry, if enterprise ever is to be freed from the fluctuations of activity that carry in their flow inflation of price and credit, and in their ebb deflation with corresponding waste, represented by inventory losses, idle plants and unemployment following upon the contraction of credit.

Association ostensibly for the dissemination of such information as will stabilize production and eliminate much of the waste incident to competition, without destroying this essential to progress, have yielded to the enticement of power in the maintenance of prices. Instead of combating an evil, as e. g., the retention of inflated war-time wages, the tendency would be to embrace it and to seek to pass a progeny of evils on to the consumer with the inevitable stultification of the industry itself.

To the extent that association is resorted to to restrain the severity of the competitive process, it is to be condemned; to the extent that it qualifies the industrialist, by the fullest public information of production conditions, to guide intelligently his enterprise, it is to be commended and aided.

But any mechanism that serves to keep alive production units in the twilight zone of uncertain economic utility, in opposition to the law that decrees the decline of prices to the cost of producing that portion of the supply of a given market that is produced most disadvantageously, perverts a natural process at the cost of all. These denizens of this twilight zone have their future, in an era of declining prices and over-built production capacity in amalgamation, merger or extinction.

READJUSTMENT, drastic as it already has been, has far from run its course, for with production capacity greatly in excess of domestic requirements and with a [illegible] political philosophy that denies payment for our surplus products [illegible] in the only way the necessitous consumer can pay, viz., with his manufactured goods, or by services which we are seeking to perform ourselves, expectations of early general resumption of business find poor support in the facts.

The illusion that war enriched some nations at the cost of others is dispelled in the writing-off of billions put in production and distribution equipment for which peace hath no present use. In basic heavy chemicals alone, our pre-war production capacity of 300,000 tons of caustic soda is stated now to be 600,000 tons; from a production of 2,235,000 tons of sulphuric acid (100% H_2SO_4) in 1913, the end of 1918 found us with a capacity for 6,000,000 tons.

The slow and spotted improvement in fundamental domestic conditions is made against a recalcitrancy to natural law that seeks to enforce an artificial and unjust basis for the stabilization of values. We find this resistance on one hand in the attitude of organized labor which spurns cooperation from which it primarily would benefit, and on the other hand in a sense of national irresponsibility to world obligations, that appreciates not the blessings of reciprocity and the evils of retaliation.

In an era of under-production and declining world prices every influence that tends to suppress demand for goods should be eradicated, for which we have only the slow processes of popular education to combat sophistries that would penalize the whole to benefit a part. Resumption of normal demand awaits the adjustment of labor costs to prices that the people can pay, without which the manufacturer can not produce for domestic consumption or be able to compete with foreign producers.

How illogical it is to demand a policy in our international relations that restricts the ability of foreign buyers of our surplus production to pay for what we must sell if our own people are to have employment! Otherwise must the products of farm and mine and factory, with the present state of our capacity to produce, be restricted to domestic needs, with the inevitable reduction of living standards consequent upon the absence of the abundance and cheapness of goods upon which such standards rest?

The more there is produced the more there is to divide, in a world dependent as never before for the common welfare upon the prosperity of each part. Progress is a necessity which can be denied to none only at the common injury.

ON a recent occasion at Rumford Hall, New York city, the activity of a nonentity on Long Island in selling stock in a company capitalized on some hocus pocus to increase the mileage of gasoline, was seized upon as an example of how a chemical publication could serve the people in exposing projects whose chief aim was to sell stock to gullible investors, a service early undertaken by CHEMICAL AGE.

On July 1, 1919 CHEMICAL AGE stated as regards one enterprise: "Any worthy chemical enterprise can be financed readily at the present time without recourse to the public via the [illegible] procedure of the New York Curb." On July 2[illegible], 1919, CHEMICAL AGE stated as regards another enterprise in chemical stock jobbing: "The sober opinion of the industry condemns such procedure. The stability and integrity of the industry are the creation of constructive work that caters not to a public passion." In these examples, which CHEMICAL AGE condemned, chemists had no part.

Would you advise investment in a concern organized to make soap out of corn meal, soda ash and cocoanut oil, if you knew that the pathway of the soap industry, up from the days of its practice as a household art, is strewn with stock-selling casualties; particularly if the promoter advertises that he had signed a "contract for the sale of close to $5,000,000 of this product," and at the same time disclosed a list of directors apparently amply able to finance this transaction without resort to the sale of securities to the frugal and the ignorant; particularly if in the same advertisement he bragged about his school for stock salesmen, the most successful of which he will turn into salesmen for the product?

In the face of his statement that already he has secured $1,500,000 from the sale of securities, and of the relatively inexpensive manufacturing equipment in this art, unskilled labor, in fact a plant already built, and $5,000,000 worth of products sold, one pauses to ask how much capital he anticipates securing.

It is stated that more than one billion dollars are wasted annually in worthless securities. With all the agitation to subject stock exchanges to state control and to enact legislation to save the fool from the loss of his money, would you not think that reputable chemists would be wary not only of the use of their names, but of participation in stock-selling schemes?

Here is a "blunderbuss mixture" that cries for the official consideration of Dr. Ittner.

MEN in industry have got to pay for supervision; those who pay least get the biggest wage, and vice versa.

Chemical education, among the great majority of chemically trained men, must be regarded more and more as a stepping stone to positions whereby may be reduced this burdensome personal overhead by shifting it upon others. This is the process of growth to administrative responsibility. The capable lawyer makes more money than the capable chemist, because he primarily is an administrator; and to acquire skill as a chemist means the derogation of those qualities which make men sought after for industrial and commercial leadership.

The relations of the chemist to industry are not the same as those of the lawyer; they approach a comparable basis to the degree that the chemist leaves behind him the work of the chemist in the assumption of executive responsibility, and becomes strictly comparable when the former chemist's duties as a business man are administrative, in the performance of which he counsels with the lawyer.

To ask why the chemist should be regarded as a kind of hired man, required to punch the time clock, is a confession of lack of practical plant experience and of the discipline it inculcates—in fact, of an aberration as regards the whole system of organized production. The chemist is only one element in the production of goods and always under the supervision of the man who directs production, who often is chemically educated and who always counsels with the chemist.

Whether or not the owner of a chemical business has chemical sense, one thing he must have, or there will be no employment for the chemist, and that is business sense, in which chemists as a class are deficient. It is gratifying to see the increasing number of chemists who display aptitude for business and who are gravitating to the business end of chemical enterprise.

Much of the petulant palaver of men, who advertise themselves as leaders of chemists, is a neurosis, incident to hard times and unemployment rife among the flock, in which is displayed, as regards the chemist's economic status, a functional deficiency to think straight.

This greatly is to be regretted, for unconsciously is cultivated not only discreditable reflection upon the chemist where it is desired that good repute should grow, but unwarranted criticism of the business man in chemical enterprise.

Scolding business men because they don't consort with chemists; bewailing the fact that they command them; weeping because business men lack chemical sense, plainly is hyperaesthesia, for human experience teaches that those who grow in the esteem of their fellows do so not by beseeching them to worship them, but by showing their good works among men; yet such is the gospel according to men of the type we have described.

THE constructive application of the thought developed here is that inasmuch as the chemist's salvation must be worked out in industry and the wage paid him is the measure of his value to industry, it behooves him to leave neglected no means whereby his value to industry may be increased.

The most effective means is that instrument of education which will teach him his deficiencies by contact with his fellows that they may be corrected when correction is easiest; that will disclose lines of development that he may be fitted best to pursue; that will dignify his work by organized study of its material problems as they affect the educated chemical worker; and that will dignify the man with a professional status reflecting the opinion of himself that he wants society to accept.

In our consideration of the status of the chemist, all roads lead to the "Rome" of the formation of an economic organization, created by the class for the benefit of individuals of the class that their value to industry may be increased by service to themselves. The reader is urged to analyze the thought expressed in the article on page 124, entitled "The American Institute of Chemistry." Mr. Eisenschiml's article, "Economic Aspects of the Practice of Chemistry, on page 139, will receive extended consideration in April CHEMICAL AGE.

View of New Chemical Laboratory, Brown University Architects: Day & Klauder, Philadelphia, Pa.

New Chemical Laboratory at Brown University

Description of the Jesse Metcalf Memorial Building

GROUND has been broken for the Jesse Metcalf Memorial Building, Brown University, Providence, R. I., which will house the new chemical laboratory. This building is the gift of Mr. Jesse Houghton Metcalf to Brown University and is erected as a memorial to the late Jesse Metcalf, the father of the donor.

Brown University has now in daily use a few buildings of the Colonial period. Though primitive and even austere they may appear in contrast to more ornate styles, they have a self-respecting dignity which wins for them universal admiration. It was this style of architecture which was wisely selected for the new Jesse Metcalf Memorial Building.

The structure is to be devoted wholly to the teaching of chemistry. The site has some limitations. It is at the corner of the campus made by the intersection of Thayer and Waterman streets and is limited in extent by the Memorial Gateway and the northern face of the Biological Laboratory.

The first floor is devoted to the work of organic chemistry and contains a main laboratory 44 feet 7 inches by 54 feet with accommodations for 60 students. Communicating with it are the instructor's room and the stock room. Near at hand is a smaller laboratory for advanced organic work and research. Also on this floor are offices, private laboratories and a small lecture room.

At the north end of the first floor and constituting about one-third of its plan area is the auditorium. It has seats for an audience of 270 who may reach it from either side of the building, i. e. from the street or from the campus. Adjoining is a small ell made possible by occupying below grade the 25 foot space between this new building and the Biological Laboratory. This space, lighted by areas facing the campus, serves as a preparation room for the lecturer.

The second floor is devoted to inorganic work and physical chemistry and has one large laboratory 45 by 74 feet at the south end accommodating 60 students. There are also 4 smaller laboratories. Of these one is 22 ft. by 70 ft. for 42 students; another is 13 ft. by 45 ft. for 16 students in advanced inorganic work; another is 36 ft. by 22 ft. and accommodates 20 students. The fourth is a research laboratory 13 ft. by 24 ft. Two private laboratories, stock rooms, offices, instructors' rooms, dark rooms, a lecture room and retiring rooms complete the second floor plan.

The third floor is devoted to qualitative and quantitative analysis, sanitative research, balance rooms, instructor's room, private laboratories and offices.

A portion of the building, constituting about one-third the total length, is lower than the remainder and in this lower portion on the third floor is a seminar and a delightful library. Here, in a space like a Greek cross in plan, is a reading room surrounded by book alcoves and lighted by a skylight which is concealed within a picturesque couronne surmounting the roof.

By means of numerous areas the basement is made fully available and contains receiving and unpacking rooms, storage rooms, students' lavatory, rooms for special machinery and apparatus. At the north end it is occupied by the lower portion of the auditorium under the sloping seats of which, as they raise toward the first floor, is the plenum chamber feeding the ventilating system.

The walls of the building are to be of brick of which the Harvard variety will simulate successfully the fine texture and mellowed color tones of the neighboring old buildings which, as has been said, are the prototypes of this. The even spacing of a chosen form of windows, the band courses extending the entire length of the structure and dividing the stories, the unbroken horizontal eave, all these give to the building a dominating character of repose and dignity.

The construction is fireproof save for the laboratory furniture and the windows and doors. The floors are of the slab, beam and girder type of reinforced concrete construction. The brick walls sustain the floors everywhere save at the south end where the large laboratories occur on each floor and; as these rooms are free of columns, there is no midway support. Here then reinforced concrete columns are arranged along the exterior opposite walls to carry the floor girders. The framing of the roof is of steel; the covering is of slate.

All the larger laboratories have been planned for easy supervision by the professor in charge. Except in the case of advanced students all materials are accessible without going outside their own laboratories. Dangerous chemicals are kept in an underground room ventilated from without and reached from the basement.

The large laboratories have walls of light grey semi-vitreous brick and floors of asphalt. The tables have alberene tops and sinks, the drainage being carried in Orangeburg fibre pipe where concealed within tables, and elsewhere in cast iron and discharged into cast iron vertical lines, the principal turns being effected by open joints. The vents and fume ducts generally are of terra cotta. The heating is by means of steam from the central heating plant. The ventilation of hoods is accomplished by grouping the ducts from them and connecting each group with an electric motor and fan in the loft. All other ventilation is by means of gravity through capacious ducts which emerge from the building through the stately chimneys architecturally disposed. The desk between the two central chimneys is accessible to students and will give opportunity for carrying on experiments in evaporation.

The building runs to no excesses. It is convenient, rational and seemly and it will admirably serve the serious work which is to go on within it, while at the same time it is certain to become an architectural asset to Brown University and to the community.

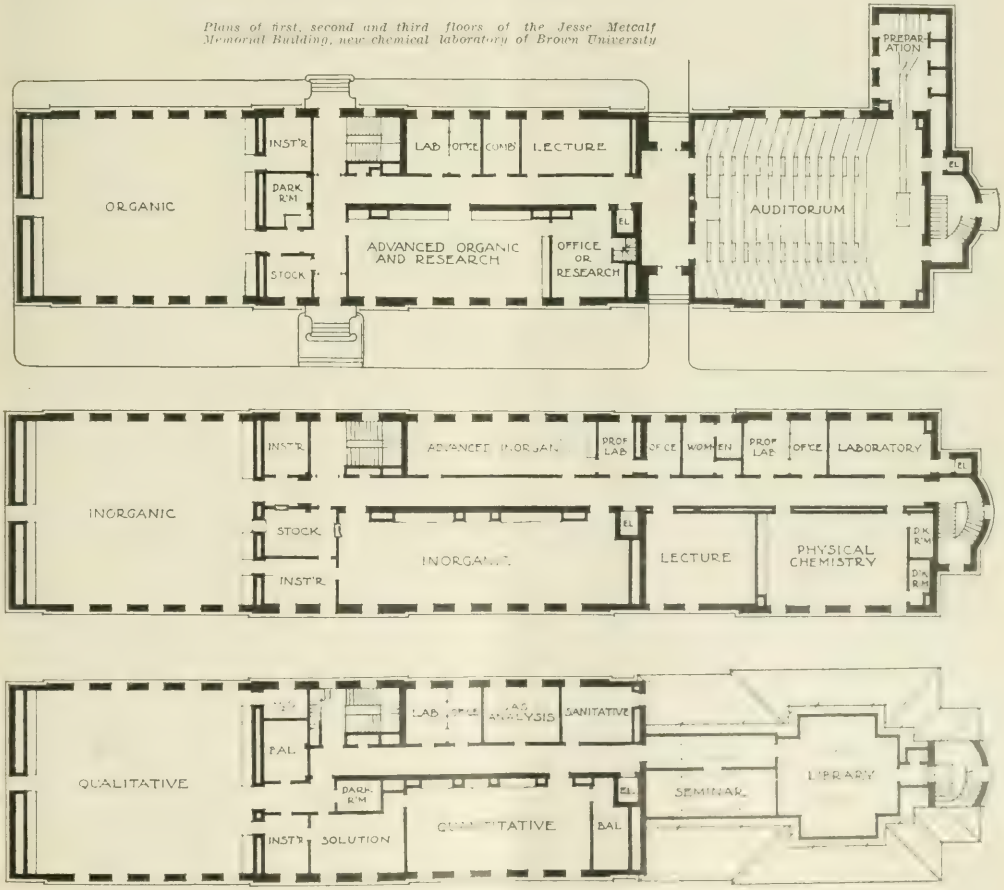
Natural Gas Consumption from Monroe, La., Wells Reduced

The Louisiana State Department of Conservation has limited the consumption of natural gas from wells in the Monroe field, previously limited to 25 per cent. of their open flow capacity, to 20 per cent. of their open flow capacity.

Commissioner Alexander says: "The proven territory of this field has recently been increased by 38 square miles, making the total proven area something over 250 square miles. Present estimated potential capacity of the field is approximately 800,000,000 cubic feet a day. The present consumption is approximately 110,000,000 cubic feet a day, based upon a 25 per cent. take on the open flow capacity of the wells.

"The effect of the rule we are now putting into effect will be immediately to reduce this amount by 20 per cent. It would not be advisable arbitrarily to close the wells from which gas is now being taken and used, after extracting the gasoline, in the manufacture of carbon black and for industrial and domestic use, for the reason that the rock pressure is very great, and, from an engineering standpoint, to close them would endanger the field itself through possible blow-outs and eruptions. The effect of this order will be to bring the amount of consumption within a reasonable safe limit.

"The Department of Conservation is keenly alive to the necessity of conserving this resource for domestic consumption and for the greater industrial development of the state, and Governor Parker is entirely in accord with this purpose."



Plans of first, second and third floors of the Jesse Metcalf Memorial Building, new chemical laboratory of Brown University

American Institute of Chemistry

PURSUANT upon the conviction of a large number of the younger element of chemically trained men in New York City that if a project is worthy of consideration, and being found good, it equally is worthy of being carried into execution, initial steps are now under way to organize the American Institute of Chemistry, New York Section.

Organization will be effected under the membership corporation law of the state of New York. This will provide not only the maximum dignity and assurance of corporate permanency, but will compel the interest of all chemically trained men in chemical enterprise throughout the state.

It is not deemed practicable or desirable to organize in New York state along the lines being followed in New Jersey. In New Jersey is the embracing popular organization, the New Jersey Chemical Society, which seeks to align chemical enterprise within the state with the other organized activities of its industry and commerce. Out of this embracing organization is being segregated that capacity which seeks recognition of its professional status in the functions of the professional organization—American Institute of Chemistry—New Jersey Section.

Tripartite Administration

The charter members of the New York State organization, in accordance with the principles that already have been enunciated as regards the American Institute of Chemistry, will represent the three classes of individual chemical enterprise and will comprise the younger element of chemically trained men. These classes are (1) the teachers of industrial chemistry who in institutions of technical education supply the administrative raw material of chemical manufacture, (2) works chemists in executive positions in production, and (3) those chemists who through native ability have used their chemical education as a stepping stone to business administration. Briefly, these men are (1) teaching chemists, (2) production chemists and (3) business chemists. It is important to the success of this distinctive type of segregation that this tripartite administrative control shall prevail.

Let it be understood clearly that the American Institute of Chemistry is an organization of a professional character with fundamentally economic purposes as relate to the development of the potentialities of chemically trained men.

It complements and correlates the functions of the American Chemical Society as our scientific organization. It not only would relieve it, as properly it should be relieved, of attempted functions illy performed, but would compel its undistracted devotion to needed and commendable scientific educational service. These two organizations forcefully may be compared in that one helps to educate the chemist while the other [illegible] helps him to progress and so to make the most out of himself. The latter function is distinct from the former and is of a character that suffers in performance by being made [illegible]

The Teaching Chemist

Enrolling among the [illegible] charter members of the American Institute of Chemistry—New York Section, will be a selected teacher of industrial chemistry from each of the following institutions of chemical education in the state:

Columbia University
New York University
College of the City of N. Y.
Brooklyn Polytechnic
Cornell University
Syracuse University
University of Rochester
University of Buffalo
Union College
Rensselaer Poly. Institute

It is desirable that these representatives be those whose ancillary duties have to do with placing the institution's men in industry, to the end that their connection may enable the organization most effectively to perform one of the Institute's most important purposes, which is to receive into membership the graduate chemist and to place him and to help to keep him placed where his native ability and acquired talent may find fullest expression. Chemical industry progresses only as its personnel develops; helping the individual is the most effective way to help industry.

Emphasis has been put upon the fact that the appeal of the American Institute of Chemistry is to the younger generation of chemists—not alone to the stripling out of school but to men from 28 to 40 engaged in practical work, who appreciate the responsibilities that they owe not only to the younger men but to themselves to make chemical industry "safe" for chemists. These men feel that accessions to their ranks should be with increasing scrutiny that chemical industry may be aided by selection and that inevitable errors of judgment may be concentrated into the earlier years that recuperation may be briefest and results least harmful.

These men feel the economic helplessness incident to highly specialized work and are keen to appreciate the usefulness of an organization based on the humanitarian principle of "all for each and each for all," when conditions of readjustment, always impending in our intensive industrial life, may become necessary.

The American Institute of Chemistry aims to be a humanitarian economic society to which each member can turn as a matter of right for service to be rendered as a matter of duty—on the one hand without embarrassment or apology, and on the other without subterfuge or evasion. The American Institute of Chemistry will play no favorites. It will be the tail of no kite.

In its appeal to the younger generation of chemists the American Institute of Chemistry seeks to provide opportunity for experience in the work of organization in the conviction that the most virile, useful growth is not from the top down but from the bottom up; whereby the organization reflects the thoughts and aspirations of its members and so functions properly as a tool of the members, in contradistinction to the utilization of the body of members for the purposes of a few.

The Production Chemist

Production chemists are those whose material salvation is worked out in the plant, into which they enter either via the laboratory, graduating usually from the routine control work therein, or directly as novitiate chemical engineers to run a piece of apparatus and to learn to handle help, evolving eventually into plant superintendents and less frequently into chemical business men.

This work often is dirty, in building construction [illegible] and in contact often with low-grade unskilled labor. [illegible] chemical manufacture. These men, doing yeoman service in the progress of chemical art, often can be recognized by the appearance of their hands.

As regards this highly valuable class of chemically trained men, let it be said that, in an environment such as we know from practical experience and have briefly indicated, they, tired at close of day, go home to sleep, and find in listening attendance upon the stereotyped meeting of chemical societies the basis of but little refreshment. In marked contrast with this type of chemist has been evolved the "talking" chemist, apparently called into existence by the highly questionable belief that men of the former type need a press agent.

The thought that we wish to enforce here is that they do not need a press agent, nor do they desire one. What they do need, not only for their own benefit, but for the help of others similarly situated, is frequent participation in meetings of their kind whereby they may enjoy an antidote to the furtiveness bred by such industrial isolation.

These men are of the creative and directive type and find pleasure in constructive work as befits their position in chemical industry. However much they appreciate the scientific basis of their work, their thoughts run along economic lines because their responsibilities are to reduce production costs and maintain quality and to expand manufacture by every means that will encourage consumption.

The primary purpose of the American Institute of Chemistry is to increase the resourcefulness of men of this type, for thereby is industry helped directly and effectively, and, accordingly, they will constitute the second element of control of an economic organization dedicated to making the most out of chemically trained men. Their representation among the charter members of the New York State Section of the American Institute of Chemistry assures its distinctively practical character and augurs well for their co-operation with the teaching chemists who train the men they hire.

The Business Chemist

In the business chemist is most notable the triumph of inherited over acquired characteristics, for the ability to trade and to administer a manufacturing organization can not be acquired from books. It is a gift forged into creative usefulness on the anvil of experience, and to which Nature bends the man.

Men of this type look upon chemists as tools useful only as they prove themselves essential to the purpose of the manufacturing organization, which is to make money. With the increasing accession of chemically educated men to the ranks of industry and the necessity of chemical knowledge to the successful conduct of chemical business, the field for selection of men of this type is broadened, with the result that less dependence is being placed upon men who know only how to buy and sell. Numerous examples of chemists successful as business men make not remote the day when the successful chemical enterprise will be manned from top to bottom by chemically trained men.

Of common academic origin these men view with sympathy the ambitions of their kind and have learned in varying degrees the great lesson of experience, which is that men grow only as they help others to grow. This third element in the tripartite control of the economic organization of chemically trained men completes a system wherein plays the activity of the member during his connection with chemical enterprise from youthful student to mature industrialist.

Essential to the development of professional consciousness is the appreciation of solidarity of interest. The cultivation of this attitude toward one's fellows and the common object of life which is progress is aided most effectively by that type of association which is predicated on the desire to improve one's status. There is a world of difference between seeking to show how clever we are, which is centrifugal, and seeking to help ourselves which is done by helping others, which is centripetal. The economic type of organization is centripetal as is all organization that draws men together under a common impulse, whether it be helplessness, ignorance, fear or their opposite, the desire for strength—not as an instrument of oppression but as a source of inspiration for increased efficiency in one's work.

Plans and Purposes

The common-sense, commendable and needed activities of the American Institute of Chemistry, New York Section, not only permit readily their visualization, but provide a precedent for similar activity in other states prominent in chemical education and chemical manufacture, viz., Massachusetts, Connecticut, New Jersey, Pennsylvania, Ohio, Indiana, Illinois, Wisconsin, Missouri, and in such other states as the alertness of chemists resident therein may determine.

With headquarters in New York City in charge of a man imbued with the instinct of service to his kind; whose duty it shall be to know more about the personnel and enterprise of the chemical industry of the state than any other single individual; who is available at all times for the service of any member in the state; who is the personal representative of every member in the state wherever located; whose office is the New York office of each member; who is appointed by officers and directors elected by open ballotting; with student sections in each institution of chemical professional education within the state whose members become on graduation members of the American Institute of Chemistry, New York Section, and a responsibility, in conjunction with the institution, to place in industry where their potentialities have promise of fullest expression.

Such activities, briefly suggested and in small part only, are open and above-board; are in no way analogous to the functions of a licensed employment agency whose net income appears in ways remote from the patron's immediate interest; are without any of the mysterious discrimination of a secret society, repugnant to ways of thinking and working in an industrial system predicated on equality of opportunity. They relate to the contact of the technical novitiate with the world in which he must work out his salvation.

Organization is an instrument of education. To older men such economic organization is useful as it may correct evils growing out of our competitive system, e. g., in the promulgation of a code of ethics which is simply the crystallization of opinion as to relations and practices prevailing at the time among men engaged in the art or profession; in the ordered recognition of experience and ability in a way to command popular respect and thereby to give stability and place to the profession of chemistry; to correlate the needs of chemically controlled industry with the instructional facilities of institutions that the latter may the more effectively serve the former, whereby industry can use with the utmost service to society and hence with the greatest advantage to the individual the men turned out by the schools; the determination of industrial needs and the regulation of their supply in a way to improve its quality without sacrificing its morale as expressed in inferior professional status.

Incident thereto are the desirability and need of the elimination of human and material waste found in the $5,000 and 5-year expenditure on men to earn a mechanic's wage. The time is passed for turning loose this high-class human raw material without some assurance to the thrift and sentiment that make it possible that their subjects shall receive the benefit of some sort of organized consideration in their utilization by industry.

We are not unmindful of the fact that no measure of favor can release a technically educated man from the penalty of his native deficiencies, as regards his availability in industry. We share, however, with several thousand others the conviction that this type of man in chemical industry in America needs the organized help possible only in an economic organization of his kind. We do not overlook the fact that Nature distributes the awards of ability; men merely confirm her judgment; but we safely can emphasize the service, now unrendered and generally admitted to be needed, of organized study and encouragement of men of our own kind who have paid the hazard of success.

Chemists rank high, particularly in the lower registers, in economic helplessness, i. e., in their poor adaptability when exposed to the distress of losing a job. Another job in the same line not being found, perforce is jettisoned much of the dexterity or experience of the old job in the acceptance of the new place. This loss is not necessarily great among younger men, but among older men it may approach the severity of a tragedy. These consequences of high specialization of experience and increasing integration of industry, doubtless are difficult to avoid.

The point we wish here to emphasize is that the chemically trained man should leave no opportunity neglected in his early years to learn the deficiencies that may be fatal to his success, and to develop to the limit those qualities that reasonably may be depended upon to carry him through, either to the haven of a contented mind, or to the busy harbor of a congenial job. The instrument most effective in such diagnosis is economic organization dedicated to making the most out of its members.

How it will do it and with what measure of effectiveness depend entirely upon the members. Sufficient study by many men has been given to this subject to disclose a virgin field of usefulness. Opportunity soon will be provided, under leadership that will command respect and loyalty, for the younger element of chemists to effect economic organization.

American Chemical Importers' Association

Commercial chemical interests representing the importation and sale of foreign chemicals have organized the American Chemical Importers' Association whose membership embraces already about 45 New York firms. The directors are: Dr. J. Jungmann, Jungmann & Co., 170 Nassau St.; A. Jordahl, American Kreuger & Toll Corp., 522 Fifth Ave.; J. F. Wischhusen, The Superfos Co., Inc., 182 Beekman St.; F. N. Bauer, Pfaltz & Bauer, 300 Pearl St.; R. B. Bradley, Hans Hinrichs Co., 50 Union Square; A. J. Marcus, American Woodpulp Corp., 347 Madison Ave.; William Neuberg, Jr., William Neuberg & Co., 6 Cliff St.; Charles Hardy, Charles Hardy & Ruperti, Inc., 115 Broad St.

The officers comprise: Dr. J. Jungmann, president; F. N. Bauer and A. J. Marcus, vice-presidents; R. B. Bradley, treasurer; W. P. Garnett, secretary.

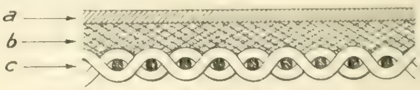
Temporary headquarters are at the office of the association's counsel, King & Wilkinson, 47 Cedar St., New York.

The association hopes to develop eventually into a clearing house for foreign chemicals, analogous to the present New York Produce Exchange. Brokers who handle imported chemicals will not be asked to join. Efforts will be made to stabilize prices and standardize goods. Definite values will be inaugurated as regards quality of different chemicals, so that confusion now said to exist can be eliminated. No standard values or tests are now available, and every handler is enabled to claim his goods the best, although year-old goods may be sold for prime, and other irregularities may occur. Some method of fair custom appraisals will also be sought, as at present purely arbitrary rulings prevail, which work considerable injury to some, while more than fair to others.

Artificial Leather Free from Clothy Appearance

Hitherto, artificial leathers have had a tendency to develop a clothy appearance, especially when submitted to pressure or tension, as for example, when stretched around a corner of an object. Charles E. Arnold, of Wilmington, Del., has devised improvements in process and product whereby the development of this clothy appearance may be avoided.

By napping the surface of a fabric, e.g., the close-mesh fabric known as double-faced moleskin, and then applying to the napped surface a nitrocellulose composition of the following ingredients (parts by weight): nitrocellulose 8; castor oil 8; solvent 84, this composition, on the evaporation of the solvent, will mat the nap into a mass which will protect and conceal the weave of the fabric. To the dried surface thus obtained another coating of nitrocellulose composition is applied. This may be of the following proportions by weight: nitrocellulose 10; castor oil 18; pigment 5; solvent 67.



a—Separate superimposed layer b—Nature of matted fibers and cementing binder c—Woven fabric

Instead of producing the artificial leather in this way, the weave of the fabric may be concealed by superimposing a layer of a material which is not woven, and which will, therefore, have no tendency to show a weave or clothy appearance. Such superimposed fabric may, for example, be a layer of felt.

Accordingly to the surface of a suitable fabric, coated as above first described and before the surface is dry, a layer of felt is applied by pressure. The surface of the felt is then coated with nitrocellulose composition similar to that of the second coat mentioned.

An artificial leather made by either of these methods will be of such a character that not only will the weave or clothiness not be apparent when located in a given plane, but even when subjected to pressure or tension, as, for example, when stretched around a corner, the weave or clothiness will not appear, but will remain entirely hidden. In this way, an artificial leather is obtained which will at all times retain its leather-like appearance.

Some Patent History and Its Lesson to American Chemistry

Told by Francis P. Garvan Before the Dyestuffs Industry Investigating Committee of the U. S. Senate.

I WANT to tell the story of how our patent convention with Germany came to be passed. We are one of the countries which have no working clause in their patent laws. Prior to 1909, Germany had a patent clause, and she still has, except as modified by treaty with special countries. This working clause in the German patent law provides that if the holder of a patent does not work under the patent within four years in Germany, he either has to license it or it is thrown open to the public.

By the year 1909 there was agitation in this country and all over the world for putting into patents a working clause. England, I think. in 1908, put in a working clause. There was agitation in this country for it. Germany, ever on the alert, wanted to forestall any such action. We had at that time in our patent office a very fine man, Mr. Moore; no finer man ever lived, a good American and everything else; but there was another side to this proposition.

There are a great many American inventors, affiliated with prominent domestic manufacturing organizations, who do not work in Germany, all having purely American inventions, who do not want a working clause operating against them in Germany. Their complaint is legitimate and should be considered. But insofar as chemical patents are concerned, their nonworking in this country was keeping out and stamping out and keeping down the development of organic chemistry.

Preliminaries of the Stockholm Convention

In the summer of 1908 or 1909 there was a convention at Stockholm of the different patent people of the world. An appropriation of $1,200 was provided for a committee to send some one there, but it was stricken out in the report.

Dr. Muurling, at that time head of the Bayer Chemical Co., and who was Hugo Sweitzer's predecessor and the American "say-so" on German business in this country, went to Mr. Moore and told him it would be regrettable if America were not represented at the Stockholm conference. Mr. Moore said, "I have no money," and went off on his vacation.

Dr. Muurling then went to the State Department, and, of course, they knew nothing of what was back of Dr. Muurling or whom he represented, for nobody in America knew the game at that time. Dr. Muurling told the people of the State Department it would be a perfect shame if America were not represented at the Stockholm conference; that we had the finest patent man in the world and that he should be sent there. Dr. Muurling knew that the State Department had a fund which they could spend for sending Mr. Moore over there. So they fell for the proposal and sent Mr. Moore over to the Stockholm conference. Then Dr. Muurling wrote to Germany and said, "I have done my part; he is on the way to Stockholm. It is up to you to invite him over to Berlin and take care of him there, for this is preliminary to our treaty."

So Mr. Moore was invited from Stockholm to Berlin, and at Berlin received conspicuous entertainment by the Royal Family and others, and the matter was discussed. The result was that they came over here the next year and this patent convention was put over.

Henry Howard and the Kaiser

Now that matter we have in its entirety. We have a witness here to whom Dr. Muurling told the story. It so happened that Henry Howard, at that time of the Merrimac Chemical Co., was the American representative at the yacht races held between Germany and America, and as such he had been to Berlin, and, too, had been wined and dined by the Kaiser, and so on. So on his return he met Dr. Muurling. Dr. Muurling, impressed with the fact that he was talking with a man who had dined with the Kaiser, was perfectly open and free, and he told Henry Howard the whole story of how Germany had put over this patent convention, and that is the treaty they seek now to revive.

The Convention and American Industry

There are two sides to that treaty; there is no question about it. It is of great value to America insofar as non-chemical industries are concerned, but insofar as our chemical industry is concerned, we feel there ought to be some discussion, and if there be any possible way by which the development of chemical science can be freed from the control over it which our present patent system gives, that way should be found and availed of.

The desire to reinstate this convention is a perfectly proper one on the part of the manufacturers who do not wish the burden of having to manufacture in Germany. We feel they should be taken care of but that there should be some differentiation made in regard to the chemical patents which are so necessary to our national defense.

Briefly, the essential clause of this convention is: "The provisions of the laws applicable, now existing or hereafter to be enacted by either of the contracting parties, under which the non-working of the patent carries the invalidation or some restriction of the right, shall be applied only to the patents enjoyed by the citizens of the other contracting party within the limits of the restriction imposed by the said party upon its own citizens. The working of a patent in a territory of one of the contracting parties shall be considered as equivalent to its working in a territory of the other party."

The essential point here is the necessity of understanding the issue and not going ahead with things without knowing what they involve; and unless we understand this organic chemical question we are into the bag before we know it.

The second thing to have in mind is that it is evidence of the importance which Germany puts upon her chemical industry, when she is perfectly willing to waive the interests of other industries in Germany about a working clause, and perfectly willing to waive all the reasons for compelling America to work her patents in that country, having her eyes solely on the interests of her organic chemical industry. Everything in Germany is sacrificed for that one industry.

The Working Clause of a Patent

For the record, let it be said that a working clause means that a given patent must be developed or made use of within a specified period, or the rights under the patent lapse. The idea patented must be put to some use, inasmuch as patents are not for the purpose of throttling progress but for the purpose of promoting progress. My contention is that Germany is greatly benefited under that clause of the treaty and by our failure to have a working clause in our patent law.

The value of a working clause becomes frightfully important at time of war. England had it and therefore she had a small nucleus of an organic chemical industry. It was small, it is true, just as small as the law would allow, for England had not developed the matter any more than she was compelled to do; but that small nucleus was there and that was the nucleus by means of which England met the poison gas attack. If there had not been that nucleus in England, I speak from the official reports, she would have been much more desperate to devise means to meet the poison gas attacks and to develop gas to meet counter attacks.

The Patent Convention Subversive of the Spirit of Our Patent Law

I now wish to submit this fact: The patent convention of 1909 between the United States and Germany was repugnant to the spirit of our patent law.

The German hold on American industry was maintained, in part at least, through compliance with the technical requirements of our patents statutes. Nevertheless, the method in which they used their American patents, in view of the purpose to which they were directed, was not in harmony with the fundamental principles of patent law in this country. The present patent convention, engineered, as stated, by Dr. Muurling, releases German citizens from ever working their chemical patents in this country. The loyalty of Robert Bacon of the State Department, and Commissioner Moore is above question, but by their action they unwittingly and unconsciously aided Germany in completing her commercial program.

This extensive foreign hold upon the chemical industry of our country was insured by the impotency of our patent laws to require the working of patents within the United States, or the granting of any compulsory license if the patents were not worked after a reasonable period of time following their issuance. The enactment of such restrictions on foreign patents in the United States has been considered by Congress but has failed of enactment. Our Government, in past diplomatic relations, has urged that no such limitations should be placed upon American patents abroad. However, it readily may be assumed that such action was taken with no idea that foreigners would use their privileges under our laws to ends detrimental to the public welfare, and without fully considering the situation that would arise in event of war involving the United States.

Of transcendent significance as regards the release of German citizens under this patent convention from working their patents in this country, is that the Germany patents in numerous instances are in no sense under the spirit of the Constitution, in that they do not disclose the advance of science whereby others may go on and make the next step. Take, for instance, salvarsan. Mr. Metz, a dealer and importer of salvarsan for years could not make it until his brother went to Germany and found out something about it, and until our Government had spent thousands and thousands of dollars in drug research. There was a tremendous expenditure of time and money, for they had practically to rediscover the whole thing. Insofar as the German chemical patents in this country are concerned there practically was no disclosure from the patent of any real practicable manufacturing procedure. If there had been such, the American chemical industry would be greatly in advance of its present position. One company that I know of spent $3,000,000 in research three years to find out something about the manufacturing end of the business.

Recommendations of the Commissioner of Patents

In his report for the year 1911, the then Commissioner of Patents said:

"In my opinion the so-called working clause contained in the laws of other countries is of such drastic nature as to discourage invention. While, of course, it is desirable that valuable inventions shall be manufactured and sold within a reasonable period from the date of the granting of the patent and not locked up by large corporations, as is now the case in many instances, it is believed that the inventor or owner of the patent should in no case be deprived of a reasonable remuneration for the invention which he has patented and thus disclosed to the public.

"In the amendment which I prepared to this section, it is provided that if the patented invention is not worked to an adequate extent after the expiration of the first four years, any person may demand a license to manufacture and sell the same, and upon the refusal of the patentee to grant such license, shall have the right to appeal to the Court of the district in which the owner of the patent resides or has an established place of business and demand an order from the judge requiring that the owner of the patent shall grant to him a license to manufacture, use and sell the invention upon such terms, conditions and security, as in the opinion of the court will be just. It is believed that such a measure will have the effect of placing all valuable inventions in public use within a reasonable time, and also will encourage the establishment of manufactories for the production of patented machines, devices, etc., which have been patented by persons who are not citizens of the United States."

The legislation thus suggested by the commissioner was not enacted. However, on the outbreak of the great war in 1914, and especially after the United States became a part of it, it was realized acutely that by the absence of necessary drugs and chemicals not only was the industrial future of the country endangered, but the very safety and health of soldier and civilian. American factories were not equipped to produce adequately many of those essentials which, prior to the war, had been supplied by imports, protected by the United States through the absence of working requirements in our law.

Thomas Ewing, Commissioner of Patents, in a letter to the Attorney General, dated May 11, 1917, in explanation of the provisions of Section 10 of the Trading With the Enemy Act which permitted the licensing of such patents, said: "Moreover, in the patent laws of any of the foreign countries there are general provisions for the granting of compulsory licenses. These provisions were not found to be of much importance and were in many respects disadvantageous prior to the outbreak of this war, but since the outbreak of the war they have become important in connection with enemy-owned patents."

Our Government may supply its own needs under existing laws, either directly or through contractors who are protected against suit or interference, the only remedy to the patentee being their recovery through the Court of Claims. But the needs of state governments, municipalities and private citizens can not be supplied in this way. It is therefore suggested that our patent statute be amended to provide that whenever a state of war exists, the Federal Trade Commission may grant licenses under enemy owned patents.

All of the discussion of this section of the Act, which readily may be referred to in the Congressional Record, has a distinct bearing on the action of Congress in subsequently amending Section 7 (c) of the Act to include the seizure of patents as soon as it was learned of the purposes to which they had been put by the enemy nations.

Conclusion

The patent convention with Germany of 1909, which the United States entered into thinking it would advance science in its various ramifications, was, so far as Germany was concerned, a part of the latter's program for the commercial supremacy of the world. Prior to the enactment of this treaty, the so-called working clause of the German patent law required inventions patented in Germany to be worked within a certain time. There were many proponents which urged that we should insure the future of this country by similar laws.

By 1908 Germany had concluded that her position in science was so strong that the working clause might be waived without prejudice, and anticipated the disastrous effects which the adoption of such a clause in the patent laws of the United States would make on her purposes. Accordingly, under the instructions of the government and consolidated chemical industries at Berlin, we had the activities of Dr. Muurling, already related, which resulted in the stunting of organic chemical manufacture in America and the hazard, portentous beyond human imagination, to American institutions and American industry.

Thomas E. Robertson, U. S. Commissioner of Patents, does not approve of the working of patents in this country as a means of checkmating the schemes of the Interessen Gemeinschaft of Germany to undermine the American synthetic organic chemical industry.

Mr. Robertson is an advocate of the revival of the German patent treaty of 1909. He has sent to the Secretary of State an appeal for action along this line which he says he believes would be to the welfare of important American manufacturing interests. The commissioner says he sees no menace to the American dye industry in revival of the treaty. He suggests that separate steps be taken to protect the interests of the dye industry, if necessary, but thinks that such steps should not include the requirement of working patents in the United States. On the contrary, Commissioner Robertson has advocated extension of the principle of the German patent treaty to other nations.

Use of Lime in the Textile Industry

By Major E. Holmes, Ph.D.

Manager, Chemical Department, National Lime Association.

THE scouring and bleaching of textiles is one of the oldest technical uses of lime. Authentic records date back to 350 B. C., at which time the Greek writer Xenophon records the wrecking of a ship near Marseilles, the cargo of which was raw linen and the lime necessary for its bleaching. The use of lime received a setback in the middle ages when the bleaching-trade guilds of England forbade its use because of the supposition that it weakened linen. In 1815, however, it came into general use again and has remained in favor in England, particularly for bleaching, up to the present.

The textile uses of lime in America have not kept pace with its foreign development and are in a very backward state. This is largely due to the use of equipment and processes not designed to take full advantage of the special merits of lime and to a lack of comprehensive information of the utility of lime and the requirements of its most effective use.

There are indications, however, that, as a result of recent research and development work, there soon may be a rapid expansion of the textile uses of lime in this country. At the present time the use of lime is restricted largely to the vegetable fibers such as cotton, linen and jute. The treatment of wool with lime is yet in an experimental stage.

The principal uses of lime in textile mills are in the processes of cleansing and dyeing the goods. Four dlistinct operations are involved, viz., (1) boiling out, (2) bleaching, (3) kier liming, (4) dyeing. Textile mills also use lime for water softening, mercerizing, for making caustic and for recovering waste lyes. These latter uses however are not special textile uses and will be omitted from further consideration in this article.

Boiling-Out

In the boiling-out or scouring process lime functions as a saponifying, hydrolyzing, neutralizing and emulsifying agent whereby the goods can be cleansed of the waxy coating, starch, tannings, pectin bodies and possibly some of the oily and resinous impurities. Cleansing is necessary in order to make effective the processes of bleaching and dyeing which follow.

The lime boil may be applied either to the fiber, the yarn or the cloth. Except in the manufacture of special products such as absorptive cotton, it is general practice to apply the boil to the goods.

The first operation in the boiling-out process is the liming of the gods which consists essentially of soaking the goods in a milk of lime. A small washing machine equipped with rollers is used for the liming operation. Either quicklime or hydrated lime may be used for making the milk of lime. It is very important, however, that lime of special properties be selected. If quicklime is used it must be properly slaked and purified and all lumps must be removed. The milk of lime is made of such a strength that when the goods leave the rollers they will carry an amount of calcium oxide equivalent to 1½-2 per cent of the goods. The goods pass directly from the washing machine through the rollers to the kier, where they are plaited down and covered with water. It is essential that no milk of lime enter the kier.

The kier boil is the second operation in the boiling-out process. The kiers are iron boilers which may be either of the open or closed type. In the closed-type kier a pressure of five to twenty-five pounds of steam is maintained. The heating is done with an external boiler which is connected to the kier in such a way as to cause circulation to and from the kier. After filling the kier with the goods, water is run in until the goods are covered. The boiling is then started and continued for about 12 hours. The boiling water is then run off and the goods washed in the kier. The goods are then passed to a washing machine where they are scoured or treated with a dilute acid solution, preferably hydrochloric acid of about 2-10° Tw. They then pass directly to another kier where they are boiled for about 8 hours in a 1.5 per cent solution of soda ash after which they are scoured, washed and made ready for the bleaching operation.

It has been suggested that in certain cases the sour between the lime boil and the soda ash boil can be omitted but that is a development which is yet in an experimental stage.

Bleaching or "Chemicking"

In the bleaching process, lime functions as a base and carrier of chlorine, under conditions which make possible the control of the special oxidation process required by the textile fibers. The oxidizing action must be very mild such as is obtainable with hypochlorite or lime solution in order to avoid oxidation or hydrolysis of the cellulose. The object of the bleaching operation is to remove the coloring matter and possibly what sizing material, grease, and dirt that may be adhering to the goods.

Bleaching or "chemicking" consists of steeping the goods in a clear bath of hypochlorite of lime of 1-2° Tw., at a temperature of about 80° F. It is customary to use wooden or concrete vats. The amount of hypochlorite solution is dependent upon the amount of goods and impurities on them. The time of steeping is dependent upon the strength of the bath, nature of the goods, etc. After steeping the goods in the hypochlorite bath, they pass through a series of washings and acid treatments which vary with the use intended for the goods.

The hypochlorite bleaching bath or "chemic" solution may be made with bleaching powder or with lime and liquid chlorine. If bleaching powder is used the process consists of beating up the powder in a small tank into a paste, passing it through a sieve and agitating with water at 75-85° F. in a larger tank. About 100 gallons of water are used for each 100 pounds of bleaching powder. After the sludge has settled the clear supernatant hypochlorite solution is drawn off ready for use.

If lime and chlorine are used instead of bleaching powder the first operation is the preparation of the milk of lime. Either quick or hydrated lime can be used, but care must be exercised in its selection. The quicklime must be carefully slaked and purified. The milk of lime is made in the proportion of 80 pounds of quicklime or 110 pounds of hydrated lime and 250 gallons of water. After thorough mixing, chlorine is passed into the milk of lime through a perforated lead pipe, reaching to the bottom of the vat. The chlorine should enter in a small stream and the temperature be kept at about 68° F. One hundred pounds of chlorine are required to bring the solution to the desired state of neutrality. After the sludge has settled, the clear supernatant hypochlorite solution is drawn off ready for use.

Dyeing

Lime has a number of possible miscellaneous uses in connection with dyeing processes. Its most important use, however, is in connection with the mordanting operation. In this use lime functions as an alkali and precipitating agent whereby the metallic salt is fixed upon the fiber. The deposition of the metallic salt is necessary to enable the fiber to hold the dye.

In the "new Turkey red" process the goods, after bleaching are treated with a solution of an aluminum salt and then washed in a bath of milk of lime. This operation fixes the alumina in a basic condition suitable for receiving the dye. In the actual dyeing operation also, lime can be used and it is recommended that the bath contains 2 per cent of hydrated lime to insure the proper depth of shade.

In the dyeing of alizarine on chromium mordants lime can be used to fix the basic chromium compounds as in the case of the aluminum compounds. The amount required is 2 per cent hydrated lime based on the volume of solution used. In vat dyeing in general, lime can be used for keeping the bath alkaline. Either quicklime or hydrated lime may be used in the dyeing operations. The remarks mentioned above regarding selection, slaking and purifying of the lime apply here with equal force.

Kier Liming

Lime forms a protective coating on the inside of the iron kier which prevents staining of the goods by contact with the iron walls.

Either quicklime or hydrated lime may be used but quicklime is preferred. Five pounds of quicklime is made into a milk of lime with fifty pounds of water. Skimmed milk or casein is sometimes added to insure better adhesion. The kier should be warm when the lime is applied. This operation is carried out with a broad brush and the entire inner surface of the kier is coated. Steam is then turned on for twenty minutes and then allowed to cool. It is then given a second coat and the steaming repeated when the kier is ready for use. The liming should be repeated every six months, care being taken to scrape off all the loose lime before applying the new coat.

Requirements of the Lime

The requirements of the lime in each of the above mentioned uses are practically the same. Contrary to the belief in some quarters, high-grade American lime is perfectly satisfactory to use and does not contain iron in a form that will stain the goods.

It is desirable, however, that the lime have, on non-volatile basis, an iron and alumina content of less than 2 per cent, a magnesium oxide content of less than 3 per cent, a silica content of less than 2.5 per cent and a calcium oxide content of more than 94 per cent. It is desirable also that the lime be fine, free of lumps and very reactive chemically.

Why a Renewed Interest in Lime by the Textile Industry

I feel justified in suggesting that the textile industry fully investigate the utility of lime for their uses because of:

1. New developments showing that the iron in high grade American lime will not stain the goods.
2. Simplification and improvement of the scouring process by the use of a dilute soda ash boil after the lime boil.
3. Safeguards against mercerization by the use of lime.
4. Better "bottoming" for the bleaching process effected by the use of lime.
5. The mild reaction of lime and chloride of lime which tends to prevent hydration and oxidation of the cellulose.
6. The protection against excess caustic action, due to the limited solubility of lime.
7. The constant concentration of the alkali throughout the boil with the use of lime.
8. The bleaching efficiency of hypochlorite of lime.
9. The prevention of excessive action on the cellulose by precipitation of the insoluble calcium carbonate.
10. The relatively small loss in weight, length and strength of the fiber by bleaching with chloride of lime.
11. The cheapness of lime and its use.
12. The relative ease and safety of handling lime.
13. The present ability of the lime industry to supply promptly high-grade textile lime.
14. The permanence of bleaching when effected by oxidizing reaction, such as hypochlorite of lime.
15. The adaptability of the lime boil to the requirements of special finishes, such as the firm, silky finish.
16. The great superiority of lime as a saponifying agent in high-pressure kiers.
17. Simplification of the kier boiling which results from there being relatively little attention required to the flow of the liquid through the kier.
18. The uniformity of scouring in all parts of the kier, resulting from there being numerous sources of a constant supply of scouring agent in all parts of the goods.
19. The efficiency of lime as a solvent for proteid matter

Commercial Pure Iron and the "Direct Process"

By Bradley Stoughton
Consulting Engineer; President, Yale Engineering Society; Past Secretary, American Institute of Mining and Metallurgical Engineers

FEW realize that the iron industry is as old as the history of man; that permanent magnets were made and used 2,000 years before the Christian era; that the hardening and tempering of steel was an art in archeologic time; and, finally, that the despised "direct process," despised because we cannot make money by it in these days when the world produces steel at the rate of a million tons every few days—was the predominant method of manufacture for thousands of years. Chemically, it is the direct process which should be preferred, instead of first making an impure product and then purifying it as much as we can afford to do and selling it to the trade. There is the continual struggle between those who want pure material and are almost willing to pay for it, and those who want to make millions of tons and get the best quality that does not interfere with big production.

For more than 50 years attempts have been made to produce pure iron on an industrial scale by means of electrolysis, which modern metallurgy recognizes as the "tonnage production" method for metals in a pure form, and which is the established process since a number of years for pure copper, gold, silver, aluminum, lead, zinc, etc.

The combination of unexcelled cheapness with unexcelled utility for many purposes, possessed by *impure* iron, has diverted attention from the superior utility of the *pure* metal over pure copper, aluminum, etc., at a fraction of the price. We now know that pure iron is at least as soft and has better cold-working or drawing qualities than either pure copper or aluminum, besides having great advantages for household and machine purposes in respect of price, durability, maintenance of a bright surface, resistance to corrosion or tarnishing, to heat, etc.

Speculations as to the properties of pure iron—that is, iron of at least 99.99 per cent. Fe.—which have been based upon researches carried out on metal having 99.50 per cent. purity, are now known to be well below the actual quality of the metal in such properties as softness, malleability when cold, ductility, magnetic qualities and, probably, resistance to corrosion. The extension of opportunities for research offered by the present industrial production of pure iron on a tonnage scale opens up a fascinating field of investigation for universities, research laboratories and others, with bright promise of discoveries having both scientific and commercial importance.

Purity of Electrolytic Iron

The only serious impurity in electrolytic iron is hydrogen, and this may be entirely removed by baking at a moderate temperature. Traces of other elements may be present by inclusion during deposition, but no great precautions are necessary to produce metal assaying 99.9 per cent. and higher. Tubes made at Grenoble, France, and analyzed in America showed 99.97 per cent. Fe., and tubes made by the Eustis process assayed 99.99 per cent.

Mechanical Qualities

The mechanical qualities of pure iron are greatly affected by heat treatment and cold working; furthermore, the presence of hydrogen, due either to original deposition or to absorption at a red heat destroys its strength and renders it both hard and brittle as well. The crystalline structure of the deposited metal is fairly coarse and well defined. It is refined on appropriate annealing, and, on rolling or drawing in the cold state, it takes a beautiful, fine structure and brilliant polish, which is more than ordinarily durable on exposure to the atmosphere, dampness, etc. Naturally this refining of the structure is accompanied by increase of strength.

An average of tests made by the National Tube Co., Pittsburgh, Pa., on tubes made at Grenoble, France, in the condition in which they were received, showed tensile strength in the direction of rolling 62,000 lb. per sq. in., and elongation of 12 per cent. in 8 in.; the average of three tests of similar material, redrawn and annealed at 900 deg. C. for 20 min. gave 39,000 lbs. per sq. in. tensile strength and 30 per cent. elongation in 8 in. The bursting strength of a Grenoble tube 4 in. in diameter and 0.03 in. thick, was 1110 lb., corresponding to a fibre stress of 73,500 lb. per sq. in. It is very probable that pure iron, like very soft steel, would increase greatly in tensile strength without losing much in ductility by subjection to a double heat treatment.

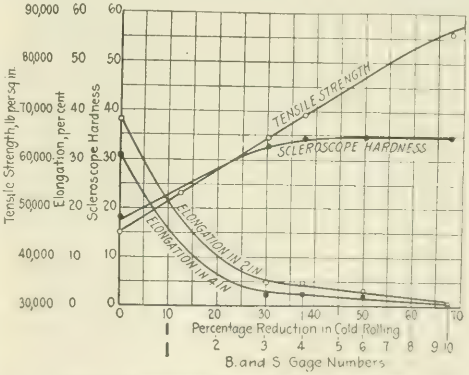


Fig. 1—Characteristic Curves of Electrolytic Iron

Cold-Working Properties

In *Le Génie Civil** tests are described and photographs given showing the extraordinary softness and cold workability of the Grenoble tubes. Escard says it is the regular practice at Grenoble to draw five times through a die without annealing, as compared with the customary practice with soft steel to anneal before each draft. This statement is corroborated by tests made in America, at the plant of the Stanford Steel Products Co., of iron made at Grenoble and iron made by the Eustis process. Tests of cold rolling, deep stamping after cold rolling and without annealing, cold rolling and beading, threading, etc., showed that the electrolytic iron would undergo work with much less frequent annealing than soft, open-hearth steel, and would endure more cold deformation without cracking than ingot iron, Toncan metal, and, in some instances, electrolytic copper.

This softness and ductility open a wide field of usefulness, because the saving in cost of annealings alone, which is an expensive item in cold rolling work, is an important economic feature, besides the greater ease of working and lessened defective articles. Additional light on the cold-working qualities of pure iron is shown by Fig. 1, "characteristic curves," with which are compared soft steel (Fig. 2), electrolytic copper (Fig. 3) and "tubing metal" (Cu 75%; Zn 25%), (Fig. 4). The last is given because its qualities so much resemble those of pure iron.

---

*August, 1919, et seq.

Table of Tensile Tests of Electrolytic Iron Tubes
(Made at Grenoble, France)
(See also the physical tests in "Characteristic Curve," Fig. 1.)

Ultimate Strength, Lb. per Sq. In.	Yield Point, Lb. per Sq. In.	Elongation Per Cent.	Elongation In.	Reduction of Area, Per Cent.	
72,600	.....	1.0	2	..	Cold rolled; tested in direction of rolling.*
78,500	.....	8.0	4	..	As received; tested direction of drawing.†
57,800	..	0.5	2	..	Cold rolled; tested in direction of rolling.*
62,000	52,000	12.0	8	50	As received; average.‡
38,300	..	0.5	1	..	Cold rolled; tested across direction of rolling.*
39,000	27,000	30.0	8	60	Annealed; average of three results.‡
41,[illegible]	. .	35.0	4	..	Annealed; tested in direction of drawing.†

---

*Tests made at Columbia University. †Tests made by General Electric Co. ‡Tests made by National Tube Co.

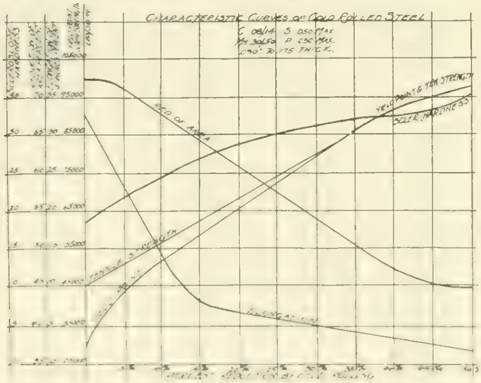


Fig. 2—Characteristic Curves of Cold Rolled Steel
C .08-.14; Mn .30-.50; S .050 max.; P .050 max.

Resistance to Corrosion

A test made at the Massachusetts Institute of Technology by Prof. Carle R. Hayward showed that a piece of Byer's wrought iron pipe corroded nearly twice as much, and Shelby steel tubing 2.6 times as much in the atmosphere as electrolytic iron made by the Eustis process. According to the same authority, an immersion test of 22 hr. in 5 per cent. sulphuric acid gave a ratio of loss of weight per unit of area:

For electrolytic iron..................	1.00
For steel	[illegible]
For wrought iron	[illegible]

Production of Pure Iron

Where cost is of secondary consideration, pure iron may be obtained by reduction of relatively pure ores by means of hydrogen. This is a "direct process" which, like most such, cannot compete commercially with the indirect method of smelting the ore to impure pig iron and then refining this by from one to four subsequent operations. Round-about and inefficient as this may seem, it can be carried out on so large a scale and so rapidly, as to exclude the direct method from industrial competition, and only those who are ignorant of the fundamental principles are any longer led astray commercially by the easy reducibility of the iron oxide and the technical simplicity of the direct process.

But, where purity is of primary importance, direct reduction is of great advantage. This operation was carried on by the Western Electric Company for a time to produce iron powder with special magnetic and electric properties appropriate for telephone apparatus. Research engineers of the company say*: "The two main objections to this material were the high cost of production and the fact that the reduced iron was very soft. The latter is a serious defect, as has already been pointed out, in case the material is to be used for cores in the highest grade of loading coils. The pressing of the iron powder introduces a considerable amount of mechanical hardness but is insufficient to give the material as good magnetic qualities as the 65-permeability iron wire. The introduction of other means of hardening the material, although possible, would increase the cost of production.

"When studying the question of obtaining a source of supply, one of the authors concluded that if iron was deposited from a suitable electrolyte it could probably be ground to the required fineness and it would also have the additional quality of being a hard material. This method of producing iron powder would also be relatively inexpensive and the quality of the material could be controlled a great deal more readily than in other methods of production. Work was immediately started to investigate this possibility and the preliminary work was so encouraging that a good-sized experimental plant was installed."

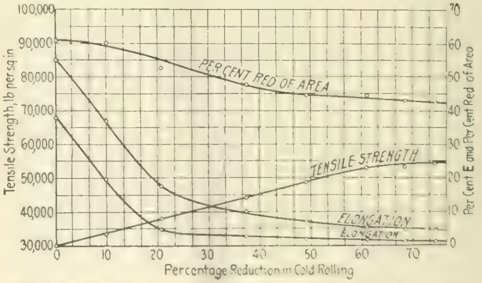


Fig. 3—This Characteristic Curve of Electrolytic Copper Represents the Change in Physical Properties Which Accompanies Cold Working of the Metal. The abscissæ represent percentage of reduction in cold rolling.

"Satisfactory material was obtained by electrolysis of a solution containing ferrous sulphate and chloride and ammonium sulphate, using anodes of mild steel and cathodes of polished sheet steel, with current densities of about twelve amperes per square foot. The cathodes were removed when the deposit had reached a thickness of ⅛ to ¼ in., and washed in hot water to remove the electrolyte.

"Powered iron cores are today manufactured in large quantities by the Western Electric Company at Hawthorne, Illinois. The present equipment has a capacity of 25,000 pounds of iron powder per week."

There also has been in operation since 1915, at Grenoble, France, an electrolytic plant, using ferrous chloride as the electrolyte and cast iron (often in the form of scrap) as the anode. The iron is deposited on a revolving cathode, and is used direct, after annealing and sometimes a few drafts through dies, as boiler tubes of great purity.

---

*Journal Am. Inst. of Elect. Engrs., July, [illegible]

Electrolytic Iron Direct from Ore

The deposition of iron by electrolysis is from the electrolyte directly on to the cathode. The use of a soluble anode is only a means of keeping the electrolyte supplied with iron. Any other means of accomplishing the same result would give the same deposition, electrical efficiency, etc. For example, the circulation of the electrolyte, always maintaining it up to the desired standard of iron content, would affect the electrolytic action and avoid some disadvantageous features, such as the economic waste due to the loss in slimes with the soluble anode, the migration of impurities from anode to cathode, etc.

This is the novelty introduced by Frederick A. Eustis and Charles P. Perin in patents issued the former and developed jointly by them. This process has passed through the laboratory stage and commercial installation is under way. The solution of iron ore is the means of keeping the electroyte enriched in iron in proportion as it is impoverished by the electrolytic deposition. The electrolyte is ferrous chloride; the anode is of some insoluble material such as graphite; the current density is 50 amperes per sq. ft. The cathode may be a revolving mandrel on which the iron is deposited in the form of a tube, or it may be in the form of a sheet, or a traveling belt from which the crumbs are removed continuously by mechanical means.

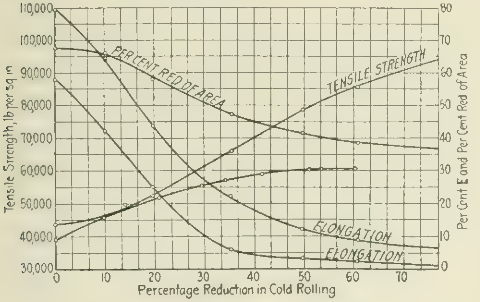


Fig. 4 Characteristic Curves of Tubing Metal.

The process thus resembles the copper leaching and deposition process so successfully carried out at Ajo, Arizona, and elsewhere, and the established process of electrolytic zinc production. It may be employed in localities where iron ore and a market for iron and steel exist, but where solid fuel for smelting is costly. It differs from the usual "direct process" in that it can deliver a product in finished form, ready for market, instead of a "sponge" which is commercially equivalent to a poor grade of steel scrap and must be submitted to several processes before it has industrial usefulness. It differs from the electric smelting of iron in that it will produce a very pure product without the use of any flux.

Obviously, it can be applied to any iron ore capable of solution, but its cheapest raw material is the abundant sulphide ores which occur in many parts of the world and which sell at a low price, because (1) of their abundance, and (2) their inapplicability to blast furnace smelting until after a process of complete roasting. Such ores also yield their sulphur content as a by-product, at a price which more than covers both the cost of sulphur production and the total cost of the ore itself.

Application to Sulphide Ore

The present projected application of the Eustis process is to an iron sulphide ore containing a small amount of copper, and the operations will deliver in marketable form the iron, the sulphur, and the copper in one short series of processes.

Pure iron is deposited on the cathode and the ferric chloride formed in the anode compartment is used over again for leaching, thus making the process cyclical. Sulphur is recovered as brimstone and copper is precipitated out on scrap iron. The speed of leaching depends on the fineness of pulverization of the ore, but presents no difficulties whatever after extended laboratory tests, although it is important to avoid unnecessary use of chlorine by mechanically separating such oxides as lime and magnesia before solution. Leaching is assisted by the circumstance that the reaction is exothermic. Counter current extraction has resulted in delivering 97 per cent. of the iron, and 90 per cent. of the sulphur content of the ore.

It is unique in metallurgy for one brief cycle of operations to deliver in marketable form more than 90 per cent. of any ore.

The Commercial Analytical Laboratory

It is almost universally admitted by consulting chemists that their analytical laboratories operate at a loss. Why? Certainly not because the salaries of the chemists employed in them are too high. The reason is found in the prices charged for analyses. These prices are too often fixed by the probable reaction of the "trade" toward them rather than by the actual cost to the consulting chemist.

When a business man finds that a department of his business no longer pays he discontinues it. When the chemist finds that his laboratory is losing money he attempts to justify its existence by demonstrating to himself that it is the means of bringing to him problems that show a profit. He apparently operates with the thought that in all events the analytical laboratory must go on, whether it pays or not.

If this situation affected only the relatively few consulting chemists and their employes it would be of minor importance, but since the manufacturer determines the salary of his chemist by the cost of the work he does if it were sent to a consulting laboratory, it assumes greater proportions. The chemist's salary reflects the value of his services to industry. If the market for these services is too low, due to an artificial condition, he suffers an unnecessary loss. Raise the prices of analytical work to a level which will permit decent salaries for analysts and a profit for the laboratory.—*A. W. Landstrum in The Chemical Bulletin, Chicago.*

Dr. Hugo Schlatter, formerly of the chemical products division, Hercules Powder Co., has opened an office in the Girard Building, Phila., Pa., for chemical engineering practice in cellulose products.

* * *

Clarence J. West and Callie Hull of the Research Information Service of the National Research Council, announce that of the 332 doctorates conferred by American educational institutions in 1921, 134 were in Chemistry, with Chicago University leading with 42. Chemical doctorates in 1921 increased 50 per cent. over those of 1920, when they showed recovery from wartime distractions which reduced the output to 54 in 1919 from the previous high of 115 in 1916.

Fig. 1. Unfinished plant of Eastern Potash Corporation, near New Brunswick, N. J. Construction abandoned because of loss of market.

Rise and Fall of the Domestic Potash Industry

As a résumé of the origin, growth, decline and fall of the American potash industry, the following statement of grievances and petition for relief, contained in the document addressed to the Congress of the United States, is eloquent of the enterprise of American chemical engineers and American capitalists to establish a domestic potash industry.

Entirely aside from all that can be said as to the geographical specialization of industry and of the essentials of the restoration of normal exchange, it cannot be denied that the pioneers of the American potash industry have been treated with such summary injustice as to warrant the consideration of the American people as to the importance of their enterprise to American welfare and to the necessity of its conservation. The statement runs as follows:

The undersigned, producers of potash in various parts of the United States, finding the markets closed to us, our great investments non-productive, our plants and factories compelled to shut down completely and thousands of employees out of work, through evasions of the laws of the United States by the German potash monopoly controlled and directed by the Government of Germany, do hereby submit the following statement of grievances and petition for relief:

I. The German Government, through one of its official agencies for trade expansion and domination, the Deutsches Kali Syndikat, has, to all intents and purposes, destroyed property owned by American citizens to the extent of about $30,000,000 during the past twelve months.

II. This destruction was performed deliberately with the intent to stamp out American competition with the German potash monopoly which seeks to regain its world-wide control of a necessity of life.

III. German agents threatened and predicted this action just before the United States declared war on Germany in 1917, in an endeavor to frighten American citizens from investing their money in this industry.

IV. The German Government is officially responsible for this recent destruction of American property and its officials are now laughing at the plight of the American producers.

V. While the United States and its Allies were engaged in the World War, the German Government and the German potash monopoly were preparing for the destruction of American property after the war, and compelled more than 10,000 Allied prisoners to assist in the preparations.

VI. German agents are now conducting an extensive propaganda in this country to mislead Congress and the public about the needs of the American potash industry to the end that it may be denied the protection it seeks from foreign aggression and may never be revived.

Before the World War, Germany had a monopoly of the potash production of the world. The output was controlled by the German Government, which fixed prices, received a share of the profits, and maintained an official bureau for pushing the sales of the product. The arrangement constituted an official "trust" or "kartel," called the Deutsches Kali Syndikat, or German Potash Syndicate, with a capitalization of 1,600,000,000 marks, or $380,000,000 at the normal rate of exchange. The profits of this trust were very large.

The United States was one of the largest consumers of German potash, importing more than 200,000 tons a year. This was used principally as one of the ingredients of fertilizer for truck gardeners, potato growers, and tobacco and cotton plantations. The amount of potash so used varies from 40 pounds to 200 pounds per ton of fertilizer.

Origin and Extent of the American Potash Industry

When the supply of German potash was cut off by the war, the fertilizer industry, farming interests and government officials called on the chemists of the United States to develop a native potash industry. It was found, after a considerable expenditure of public money, that almost inexhaustible supplies of potash were obtainable in the United States, particularly in the States of California, New Jersey, Nebraska, Utah, and Texas, among others.

In this emergency, the chemical industry of the country responded and began the development of a great business. In 1915, after repeated costly experiments, with the aid of the U. S. Department of Agriculture, over 1,000 tons were produced commercially. This production increased until, in 1918, 54,000 tons were obtained, and some of the plants were just beginning to get under way. In 1919 imports resumed and the native production began to decline, until in 1920, over 200,000 tons were imported, with only 48,000 tons produced in America, and in 1921, all the American plants were compelled to shut down because of Germany's successful evasion of the "Anti-Dumping Act" and the selling at "cut rates" of enormous quantities of potash below the American cost of production.

The methods of producing potash varied, according to the source, from the brine lakes of Nebraska, Utah and California, to the waste from the beet sugar factories in Michigan, which produced over 3,000 tons in 1920. The industry is widely spread throughout the United States, and there were seventy-seven plants in operation in 1919, with others under construction. The processes have been perfected and there is no

Fig. 2. U. S. Industrial Chemical Company's plant, Baltimore, Md. 7,000 tons of potash produced here and not a ton sold since May, 1921.

question about the quality of the potash, which has been approved by the State agricultural departments of the seven principal potash-consuming states.

Investments Now Total Nearly $30,000,000

Beginning in a modest way, in 1915, with the investment of a few thousand dollars by the townspeople around Jesse Lake, Neb., and the neighbors of the Omaha chemist who discovered large quantities of potash in the waters of the lake, the industry grew very rapidly. By the end of 1920, the sum of $28,696,143 had been invested in the numerous plants within the United States. Some of these plants represent a cost of from $5,000,000 to $6,000,000; others a few thousands.

Potash Production and Investment, 1920

Sources and Companies.	PROUCTION: Salts.	K$_2$O.	Capital Invested.
Natural Brines, Nebraska Lakes:			
Alliance Potash Co., American Potash Co., Hord Potash Co., Nebraska Potash Works Co., Potash Reduction Co., Standard Potash Co., Merriman Potash Co., Union Potash Co.	*Tons.* 84,168	*Tons.* 21,439	$7,846,000
Other Brines:			
American Trona Corp., Borosolvay Co., West End Chemical Co., Utah-Salduro Co., Salt Lake Chemical Co., Salt Lake Potash Co., Whitney Chemical Co., Nitrate Products Co.	52,151	16,688	12,889,782
Alunite, Silicates and Kelp:			
Aluminum Potash Co. of America, Stoner Chemical Co., Mineral Products Co., Eastern Potash Corp., Liberty Potash Co., U. S. Department of Agriculture.............	4,562	2,282	4,070,000
Blast Furnace Dust:			
American Manganese Mfg. Co., Bethlehem Steel Co., Lavino Furnace Co., Lochiel Furnace, Thomas Iron Co.	2,419	183	3,000
Molasses Distilling Waste:			
Mason By-Products Co., U. S. Industrial Chemical Co., Western Industries Co., Puerto Rico Distilling Co.	9,882	3,433	717,861
Cement Mill Dust:			
Ogden Portland Cement Co., Riverside Portland Cement Co., Santa Cruz Portland Cement Co., Alpha Portland Cement Co., Clinchfield Portland Cement Co., Copley Cement Mfg. Co., Dexter Portland Cement Co., Ironton Portland Cement Co., Louisville Cement Co., Newaygo Portland Cement Co., Security Cement & Lime Co., Southwestern Portland Cement Co.	12,071	1,035	2,021,000
Sugar Mills:			
American Beet Sugar Co., Great Western Sugar Co., Columbia Sugar Co., Holly Sugar Co., Los Alamitos Sugar Co..............	8,609	3,325	921,000
Wood Ashes:			
Baraga Potash Co., Boyne City Potash Co., Wm. T. Campbell Potash Co., Cotter Bros., G. Cretens, P. Englehart, H. Fagon, Fairfield Potash Mfg. Co., Goodman Lumber Co., Great Northern Mfg. Co., Iron Mountain Potash Factory, Ladysmith Potash Co., Manistique Potash Co., Marquette Potash Co., Medford Potash Co., Oshkosh Potash & Cheml. Co., Rhinelander Potash Co., Salling Hanson Co., E. A. Thomas, R. W. Trapp, Wausau Potash Co., Wausau Soap So., West Lumber Co.................	453	299	227,500
Total	174,341	48,684	$28,696,143

The preceding table lists the sources of supply, the companies operating the plants, and their investments, with production during 1920:*

All of them are now shut down, and the carrying charges and the loss of interest are very heavy, not to speak of the unemployment of thousands of men who were thrown out of work. The producers find now that they cannot sell a pound of potash on the American market at any price, owing to the terms of the German contracts with the fertilizer manufacturers.

The German Threat in 1917

The American Trona Corporation, with two large plants in California, is one of the principal producers of American potash. This company built a town twenty miles from the railroad in the desert at Searles Lake, at a cost of approximately $5,000,000. The Searles Lake deposit has been estimated by the U. S. Geological Survey as being sufficient to supply the potash requirements of the United States for at least 100 years to come. The development of this supply under severe difficulties constitutes one of the greatest achievements of American chemists, engineers and investors during the war.

To the offices of the Trona Corp. in the early part of 1917, when it was practically certain war would be declared in a short time, came an emissary of the German Government monopoly, threatening destruction.

The following statements from an affidavit of an official of the Trona Corporation, made in 1919, and included in the official records of Congress on pp. 235 and 236 of the Hearing before the Committee on Ways and Means on H. R. 4870, dated July 14, 1919, which have never even been questioned or challenged by the representatives of the German Kali Syndikat, contain the prophecy and the threat which have since been so effectually and deliberately carried out:

> "Paul Freudrichsen, whose official title is propaganda manager for the German Kali Syndicate for the Western States and Hawaii, came into the offices of the Trona Corp. at different times during the three or four months immediately preceding the United States entering the World War, and stated, in the presence of Mr. Ernest Gordon, assistant secretary and assistant treasurer of the American Trona Corp., that the stockholders of the American Trona Corp. were foolish and unwise to invest their money in a potash reduction enterprise in the United States, *for the reason that the German Kali Syndicate and the Imperial German Government, would, after the conclusion of the war, absolutely destroy the American potash industry by marketing the German potash in the United States at such low figures as to absolutely preclude and bar any and all competition; that the German Kali Syndicate and the Imperial German Government absolutely controlled the potash*

---

* From p. 4698, Hearing before Senate Committee on Finance, Dec. 30, 1921.

*production and market of the world, and pictured in great detail the immensity and strength of the German Kali Syndicate, governmentally controlled, and stated that it was useless and futile for any potash reduction enterprise in the United States to undertake to compete with the German potash, for said, syndicate and the Imperial German Government intended to destroy all competition. * * **

HARRY O. TUCKER.

"Sworn and subscribed to before me this 7th day of February, 1919.

MYRON M. CADY, Notary Public.

The threat has been carried out to the letter. While there is no "Imperial German Government" any longer as the result of the victory of our troops in the war, the present government of Germany has continued its development of the potash mines and still controls the business, in the same way as before the war.

There is no occasion now to attempt to inflame sentiment with a review of the hardships suffered by the soldier prisoners who were compelled to work in the "salt mines" of Germany. But the fact remains that, through the labor of these Allied prisoners, Germany was accumulating enormous stores of potash at the mines, awaiting the period "after the conclusion of the war" to sell this product "at such low figures as to bar any and all competition," as might be expected, since it cost practically nothing.

As soon as conditions permitted, shipping through Holland or other neutrals, and finally, direct from Germany, came thousands of tons of this war prisoner potash to carry out the Kali Syndikat's threat. Having thus demoralized the American market through this "dumping," the German Government and its agent, the Kali Syndikat, determined on a final move to absolutely control the potash business in the United States.

American Middlemen Contract with Kali Syndikat

Whipsawed by price manipulations which favored one firm against another, all directed from Berlin, the American middlemen and fertilizer manufacturers who purchase the greater part of the potash used in this country, found themselves in 1921 in an intolerable situation. The Germans manipulated the market from day to day and week to week, so that there was no stability in the business, and only one thing was certain—the German Potash Monopoly was underselling the American producers no matter what price was offered.

In that situation, with some companies facing failure, owing to heavy inventories, and others fearful of making substantial purchases lest they become overstocked, the German agents approached the middlemen and fertilizer mixers with a proposition that seemed to afford some relief. Two of the leading concerns were permitted to hold a share in German potash mines, and they assisted in forming the combination with the Kali Syndikat.

In brief, the Germans offered to sell the harassed middlemen and fertilizer companies any amount of potash at a fixed price which was very low. Then they went further, and stated they would be prepared to undersell any American producer who attempted to meet this already low figure provided the Americans would agree to purchase all of their requirements from the Kali Syndikat during the term of the contract. Other inducements were offered, and a rebate, a deduction from the agreed price provided the American firms would assent to the "penalty paragraphs," and the payment by the Germans of "any tax or duties which may be imposed or assessed by the United States Government under the Anti-Dumping Act of 1921 or any amendment thereto which may be hereafter enacted."

Certain features of the proposal, such as the requirement that the American purchasers should obtain "all" of their potash from the German monopoly aroused fears that the contract offered might violate the anti-trust laws of the United States. There was a delay in the negotiations for some time until certain high officials of the German Government monopoly could come to the United States in person. Application was made for this permission by Herman Duehrssen of the Deutsches Kali Syndikat early in 1921, and was denied by the State Department, which, it was reported at the time, refused because it could not obtain assurances limiting the scope of the business to be transacted to a discussion of short term commitments. The ban was finally lifted, however, and two of the managers of the Deutsches Kali Syndikat arrived in this country to close the negotiations.

The contract was closed on September 28, 1921, on the basis of the remainder of the season's supply of potash, with thirty-four American concerns dealing in potash as middlemen and fertilizer manufacturers. It provided that these concerns should purchase at the minimum 75 per cent. of their requirements, and was in all other respects practically as outlined in the preliminary negotiations. The terms of this contract, when published, aroused a storm of protest throughout the country. But it was defended on the ground that it did not give the German syndicate a monopoly, since it allowed 25 per cent. of the potash requirements of the trade to be supplied from other sources.

The French Potash Syndicate

In the Treaty of Peace, France was given Alsace, and a few potash mines in the acquired territory. These mines were taken under control by a French syndicate, bearing a close similarity to the German syndicate. It is commonly reported, and dispatches from abroad tend to confirm the statement, that the French syndicate has made a working agreement with the German syndicate for a division of the trade. The Germans, following the tactics employed so successfully here, and, taking advantage of a clause in the Peace Treaty, began "dumping" potash in France at less than the cost of production in Alsace.

The *Frankfurter Zeitung*, June 30, 1920, gave an inkling of this situation in the following report:

> "Neither in France nor Germany has the State or the producing industry any interest in spoiling prices on the world market by competition. * * * An agreement between France and Germany as to potash prices on the world market would therefore be to the advantage of both. *At a recent general meeting of the Deutscher Kaliverein (German potash union) it was reported that negotiations were then going on with France with the object of coming to an agreement regarding the Alsatian potash industry.*"

That the negotiations have been successful, as far as controlling the potash market of the United States is concerned, is undoubtedly the fact. For, soon after the signing of the contract between the Deutsches Kalisyndikat, a contract similar in terms in almost every word was executed between the Societé Commerciale des Potasses D'Alsace, the French potash syndicate, and the same thirty-four American potash middlemen and fertilizer companies, for 25 per cent. of their seasonal requirements.

This contract expires at the same time as the one with the German syndicate. Whether or not the terms of the contract with the French syndicate were dictated by the same directing minds in Berlin, the similarity of the contracts in every particular is the strongest evidence of that.*

---

* The texts of both contracts are now before the Congress of the United States in printed hearings, on pp. 1614-1618 and pp. 1687-1691 of the Hearings of the Committee on Finance of the Senate [illegible] 1921.

Under these contracts, the American potash producers now find themselves completely cut off from their market, *because 75 per cent. of the potash used in the United States is dumped from Germany and the remaining 25 per cent. is dumped from Alsace.*

German Officials Laughing at American Protests

The following dispatch from Berlin, dated January 4, 1922, indicates how the Germans are gloating over the plight of the American potash producers, who have been "destroyed, according to plan:"

> "Berlin, Jan. 4.—A German potash syndicate will have sent 40,000 tons of potash to the United States in compliance with a contract with 34 American firms by Jan. 15, when the last shipment leaves this country. This is 8,500 tons more than is covered by contract, Privy Councillor Kempner and representatives of the syndicate informed the Public Ledger Foreign Service today. Herr Kempner hopes that the contract, which expires April 30, will be renewed. HE PAYS LITTLE HEED TO THE OPPOSITION OF THE AMERICAN CHEMICAL INDUSTRY WHICH HE IS INCLINED TO PUT OFF WITH A SMILE."*

German Propaganda Active Against American Industry

The German Potash Syndicate, admittedly, is conducting a widespread propaganda against the American potash industry. The known head of this bureau is H. A. Huston, of 42 Broadway, New York City.

The forms of propaganda employed against the American potash industry by the German interests are various. Carried on in part by a large advertising agency, it has already provoked a scandal in the publishing business.[2] It is assumed that Congress, once informed of it, will not be misled by its insidious misrepresentations.

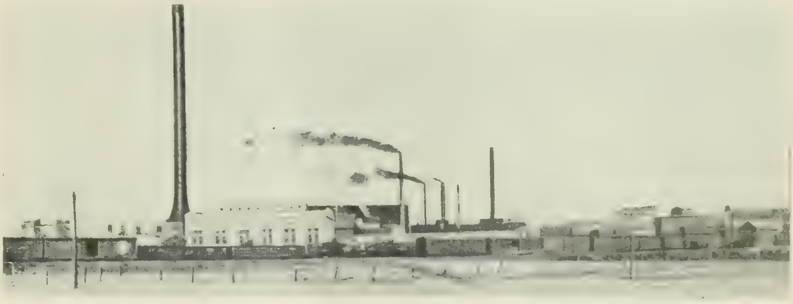


Fig. 3 Plant of the Potash Reduction Company, Omaha, Neb., working on Nebraska brines, closed down in 1921.

At the hearing before the Senate Committee on Finance, December 29, 1921, the representative of the German Potash Syndicate cited as one of his principal arguments *that the American potash industry had failed to obtain any protection, to date, from Congress.* He mentioned the failure of attempts at obtaining some sort of protection in both the Sixty-fifth Congress and the Sixty-sixth Congress, as if that proved the strength of the alien industry, and he belittled the American plants and investments.

His words recall the boasts of the other representative of the syndicate, Herr Freudrichsen, who in 1917 carried the threat to the American investors in California that "after the conclusion of the war" the German Government and the German Potash Syndicate would "destroy" American competition.

Industrial Aggression of Germany As Destructive As War

Were the German Government to declare open war upon the United States, the Congress of the United States would act immediately. Were Germany to seize or destroy American ships to the value of Thirty Millions of Dollars or even less, every available resource of the National Government would be used for defense.

Were the German Government to capture the city of Portsmouth, Virginia, drive out the inhabitants, and render useless and uninhabitable every home and mill and factory and pier and railroad station and all the other property, and erect "Verboten" signs at every approach to the city, the response would be immediate and unquestioned.

Were the German Government to "destroy American competition" by seizing the city of Taunton, Mass., or Boise, Idaho, or Montgomery, Ala., or Austin, Texas, or Bay City, Mich., or Perth Amboy, N. J., or La Crosse, Wis., or Chester or Norristown, Pa., or Amsterdam or Watertown, N. Y., or Danville, Ill., there would be no mistaking the sentiment of the country or the action by Congress and the nation.

The loss of any one of these cities would be a national calamity. Should the torch be applied, the inhabitants banished, the factories stilled, the ports closed by the German Government or any other government, by will of man or by act of Providence, the nation would be shocked, the world would sympathize. Offers of relief would be forthcoming. Troops and supplies would be rushed by train and by transport. The whole resources of the United States would be employed.

And that is equivalent to what the German Government has done within the past twelve months to the people of the United States. Towns have been depopulated. Thousands have been thrown out of employment. A new industry, essential to agriculture and to other pursuits, has been overthrown. Thirty million dollars would rebuild any one of the communities mentioned. It would be sufficient to purchase the land and erect and equip the buildings, the homes and the factories of Portsmouth, or Taunton, or the other communities mentioned.*

An Essential American Industry Disarmed

The policy of disarmament should not be extended to American industry. Yet, millions in factories and plants and machinery are being sent to the scrap heap, just as surely as the battleships, and without the formality of an international conference.

An alien combination, abhorrent to the principles of American law in its organization and methods, has ruthlessly proceeded to carry out the threat that *"the German Government and the German Kali Syndicate in-*

---

* By Cable to the Brooklyn Eagle and Philadelphia Ledger. Copyright, 1922.

[2] See Manufacturer's Record, December, 1921, January, 1922.

* See Department of Commerce Publications, Bureau of the Census, 1921. "Financial Statistics of Cities Having a Population of Over 30,000."

tended to destroy all competition, after the conclusion of the war."

If any further proof is required of the statement that Germany's threat made in 1917 has been carried out to the letter, the attention of Congress is requested to the photographs accompanying this petition depicting the character of the plants and the extent of the industry that now appeals for protection from utter annihilation. All of these plants are now idle and useless.

American Potash Essential to Farmers

The production of potash within the United States has been proved essential during war time. The other two essential elements of the fertilizers needed for plant food are now produced in abundance—phosphates from the South and ammonia from by-product coke ovens, and fixation plants.

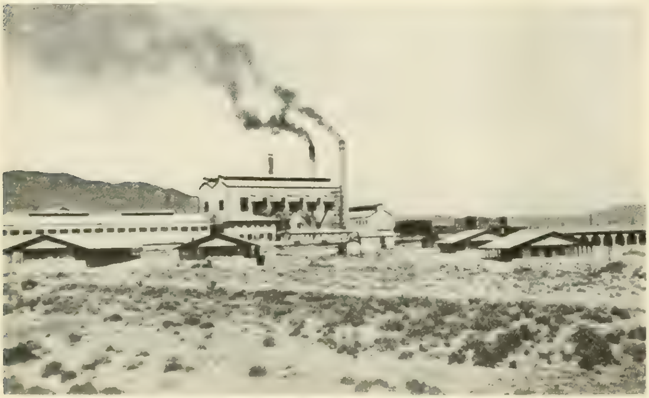


Fig. 1. Plant of American Trona Corporation at Searles Lake, Calif., now abandoned.

With native potash production protected from "dumping," all the elements of a complete, self-contained and unfailing source of supply of fertilizer for the farms will be guaranteed and safeguarded for peace and war uses within the continental limits of the United States.

No Subsidy Is Sought

Neither during the war nor after did the American investors ahd scientists concerned with the development of the potash industry seek to obtain a subsidy from the Government. They are not seeking such aid now. They are confident that if they receive the protection they request for a temporary period they will be able to compete with any other nation on an equal footing at the end of that period and thereby add another substantial asset to the nation's products and income.

The experience at the plants before they closed, gained after months of costly experiment, furnished convincing evidence that operations could be successfully conducted at remarkably low cost. It is realized that this is the only basis upon which operations can be maintained at any time, for unless the product can be sold cheaply, its market is very much restricted. In five years' time it is certain the industry can be rehabilitated and can face the German competition. If the investors did not have that assurance they would be compelled to abandon all hope of ever obtaining any returns on their investment.

Before it is too late, before rust and decay have destroyed the idle machinery and the towns now emptied of workers, these citizens trust that Congress will come to the aid of the industry. Its need can be met by the adoption of the schedule in House Bill No. 7456, now before the Senate, which provides for a sliding scale duty on imports of potash that will gradually decrease during the next five years, so that at the end of that time this material will be placed on the free list without fear of foreign "kartels" or other alien government competition.

WHEREFORE, YOUR PETITIONERS PRAY FOR PROMPT RELIEF AND ASSISTANCE IN THE FORM OF MODERATE PROTECTION FOR THIS AMERICAN INDUSTRY.

American Trona Corp., Searles Lake, Trona, Cal.; Woolworth Bldg.	New York City
Los Alamitos Sugar Co.	Los Alamitos, Calif.
Inyo Chemical Co.	San Francisco, Calif.
Mason By-Products Corp.	San Francisco, Calif.
Riverside Portland Cement Co.	Los Angeles, Calif.
Santa Cruz Portland Cement Co.	San Francisco, Calif.
Southwestern Portland Cement Co.	Los Angeles, Calif.
West End Chemical Co.	Oakland, Cal.
Whitney Chemical Co.	San Francisco, Calif.
T. Poole Maynard	Atlanta, Ga.
Utah Potash Co.	Chicago, Ill.
Samuel Ainsworth	Lyons, Kan.
William Ainsworth	Wichita, Kan.
Ben. J. Hegler	Wichita, Kan.
H. K. Lindsley	Wichita, Kan.
U. S. Industrial Chemical Co.	Baltimore, Md.
Baraga Potash Co.	Baraga, Mich.
Gustave Cretens	Escanaba, Mich.
Louis Cretens	Gladstone, Mich.
Potash Reduction Co.	Omaha, Neb.
Standard Potash Co.	Omaha, Neb.
Alliance Potash Co.	Alliance, Neb.
Hord Potash Co.	Central City, Neb.
Nebraska Potash Works	Antioch, Neb.
A. L. Gurley	Clovis, N. M.
Eastern Potash Corp	New York, N Y.
Philip Engelhart	Luckey. Ohio
Meigs, Bassett & Slaughter	Philadelphia, Pa.
Charles W. Dabney	Houston, Texas
J. L. Darrouzet	Galveston, Texas
J. H. Hill	Galveston, Texas
Roscoe Wilson	Lubbock, Texas
Aluminum Potash Co. of America	Salt Lake City, Utah
Industrial Potash Corp	Salt Lake City, Utah
T. W. Boyer, Liberty Potash Co.	Salt Lake City, Utah
Portland Cement Co of Utah	Salt Lake City, Utah
Salt Lake Potash Co.	Salt Lake City, Utah
The Bonneville Development Co.	Salt Lake City, Utah
Ogden Portland Cement Co.	Ogden, Utah
Kelp Production Co.	Seattle, Wash.
Marinette Potash Co.	Marinette, Wis.
Henry Fagon	Merrill, Wis.
Mellon Chemical Co.	Mellon, Wis.
Rhinelander Potash Co.	Rhinelander Wis.
American Potash Producers Ass'n	Washington, D. C.

The chemical properties of the unsaturated members of the aliphatic series of hydrocarbons are such as to render them "made to order" starting points or basic materials for the synthesis of hundreds of important organic chemicals. The tremendous quantities of these unsaturated compounds that are being produced daily in the various coal carbonization and oil refining processes, and which at present, have little value other than that of fuel, render a survey of the identity and extent of occurrence of these compounds important from the viewpoint of economic utilization and resource conservation. The increased need of liquid fuel and the relatively early exhaustion of petroleum resources will eventually require every utilization of liquid fuel products obtainable directly or indirectly from coal.—*Ralph H. Brown, Associate Organic Chemist, U. S. Bureau of Mines.*

Some Economic Aspects of the Practice of Chemistry

By Otto Eisenschiml

Manager, Scientific Oil Compounding Co.; President, Chicago Chemists' Club

WHENEVER an evil gathers strength, various remedies are proposed to fight it. Unfortunately, that is not the best time to evolve remedies, just as it is not the most favorable time to buy an umbrella when it is pouring.

Now that unemployment among chemists has reached alarming proportions, the subject is becoming a fashionable one for discussion. That is all very well so far as it goes, but any suggestions made at this time are liable to be fraught with bitterness or lack the proper perspective. Unless we are willing to continue discussion of this subject from now on into prosperous times, and beyond, no good will come from it and nothing will be created that is worth while.*

Preparing the Ground

One of the first things to do, it seems to me, is to clarify our own position as chemists in the industrial world. The usual fancy introductions heard in talks on chemistry about its idealistic goals and accomplishments, its service to mankind, etc., will have to be separated once and forever from straight business arguments and put into a class by themselves. We have heard so much of them anyway, that it would do no harm to go easy on that subject for a while. We chemists know it by heart, and I am sure such of the outside world as has read about it is, by this time, thoroughly impressed with the idea that we are willing servants of the industry, servants of the commonwealth and anxious to remain everyone's servants, at servants' wages.

The second subject we want to put the soft pedal on is the "broad field of chemistry with its wonderful prospects and chances for those willing to explore it." Everything that can be said on this matter has now been said several times over, and the result has been that thousands of otherwise perfectly normal boys and girls have felt the irresistible call within themselves to become great discoverers in chemical lines.

But perhaps you think that in the face of conditions as they are today such talk has come to a stop. Well, this is from an article prepared by W. D. Bancroft in January, 1921, and published in *The Journal of Industrial and Engineering Chemistry* in February, 1922.

> "The general position of the chemist is better than it has ever been before. The war has brought to the public mind an appreciation of the importance of chemistry. . . . It looks as though in the plants the ratio of chemists to engineers was going to increase considerably . . . and as though the next thirty years would be the period of the chemist just as the previous thirty years were the period of the engineer."

Is it any wonder that everybody who reads this, from Aunt Maggie to the family doctor, will advise the boy to become a chemist? And when such magazines as *Radio* publish large advertisements inviting one and all to jump into the "one profession that is not overcrowded," how can we successfully argue with those who fall for them?

An Overdose of Ethics

One more word on the ethical side of this discussion. Let it be understood that every chemist through the very nature of his calling is an idealist and an economic asset to his community, with or without his own consciousness or intentions.

This constant reiteration of idealistic compensations is becoming worse than monotonous—it is becoming irritating. It almost looks as though idealism was being used to keep chemists from pondering over their empty pockets.

Our Specifications

All remedies proposed for the betterment of our material position must first, be fundamentally correct; second, must stand the test of good times as well as bad; third, must be proposed with a view of harmonizing with the prosperity of the community as a whole, as narrow-minded selfishness will eventually defeat its own purposes.

Chemical Licenses

The thought of limiting the practice of chemistry to a privileged class, possessing a license, has been brought up several times, the idea being to keep a lot of amateurs—and worse—from trespassing on fields and honors belonging to the graduate chemists alone.

I am against the application of any such dividing line—which would be arbitrary at best and bound to give cause for endless friction. As the work of the chemist becomes standardized, industry—following the line of least resistance—will eliminate the trained chemist and supplant him with routine men or women. Legal barriers against this evolution are economically wrong. To force an industry to have a chemist spend valuable time in determining the specific gravity of a liquid by means of scientific methods when a hydrometer in the hands of a novice will reveal equally sound results is unjustifiable.

The guiding thought to keep in mind is that wages adjust themselves according to the law of supply and demand. This is the one economic law that cannot be resisted with impunity, and the only successful campaigns will be those in line with it. In other words, *we must either decrease the supply of chemists or increase the demand for them.* Any possible solution of our troubles lies hidden somewhere in this sentence.

Restricting the Supply of Chemists

Restricting the supply is a rather delicate point, and is being very neatly side-stepped by most people. Has anyone the right to direct another man's career? Will colleges shoo people away from their doorsteps? Will chemical papers co-operate in a movement that will diminish the number of their readers?

Personally, I would not advise anyone to enter the chemical profession, nor would I advise him to stay out of it. What I would like to do, is to inform every young student in chemistry of the exact conditions that will await him after graduation so far as they can be demonstrated. If all colleges would invite well-informed, practical chemists to speak to their students at certain intervals each year, it may be safely left to the judgment of the auditors as to what course they wish to pursue. In good times, the reports would be optimistic; in bad times, the reverse. Thus, the law of supply and demand would be allowed to function, even if somewhat indirectly, and outside conditions and prospects would be reflected in the number of students preparing for the profession.

The advantage of this plan lies in its simplicity, fairness and directness. There are enough sections of the American Chemical Society in existence now to cover most universities, and speakers with plenty of industrial and business experience can be had for the asking.

---

*The Chemical Bulletin, March, 1922.

Increasing the Demand for Chemists

Several interesting plans have been put forth to increase the demand for chemists. One that appeals to many is based on a general educational campaign with a view to increase the number of chemical positions or to keep industries from shutting down their research laboratories. This plan has lately been adopted by the *Journal of Industrial and Engineering Chemistry,* which is conducting a series of articles along these lines. It will be well not to be too optimistic regarding the results of these efforts. The discharge of chemists and the closing up of laboratories were preceded probably in all instances by a balancing of factors in the minds of the Powers That Be, and the conclusion must have been that the course taken was the one that would benefit that particular industry most.

A program that is much more to my liking is discussed by Dr. Stroud Jordan in the December, 1921, number of the *Carolina Chemist* and reprinted in CHEMICAL AGE. Jordan advises young chemists not to look for a job but to get into business for themselves, particularly in the South with its many dormant possibilities.

I cannot quite follow Jordan in his ideas of mixing up research during college days with business later on, but this is a minor point. There is also every reason to believe that the same arguments will apply to the North and West. If any young graduate lacks ideas as to what to manufacture for himself, let him go to a library and nose around in old formula books. Thousands of people are beginning their business ventures in this way, with no more than one formula in their possession and no chemical knowledge at all. What an enormous advantage lies with a trained set of brains against these amateurs—but even the amateurs seem to make a living.

Next in line are the various propositions that tend to turn chemists into purchasing agents, technical salesmen, claim agents, and generally into such lines of activity where technical knowledge appears to be a desirable asset. It looks very much as if these ideas could be worked out to good advantage. The average purchasing agent of today is nothing but a shopper, and in many instances does not even know the looks of the goods he buys. Chemists would not only have a wonderful groundwork of knowledge, but also the inherent desire to acquaint themselves with every detail of the materials coming under their jurisdiction. Given two men of equal intellect and energy, the chemist would undoubtedly make by far the better purchasing agent of the two.

The same line of reasoning will show that chemists should also make first-class technical salesmen, provided they are naturally gifted for a calling of this kind. There is very little doubt in my mind that if chemists could be weaned from the idea of running after jobs that do not exist, and cannot be created at will, a wonderful change for the better would be accomplished for the whole profession. The execution of this program will greatly depend on individual effort. Chemists choosing a business career will have to sell the idea to themselves first and to their employers afterward. If I applied to become a purchasing agent I would seek employment in some purchasing department without reference to my chemical diploma. I would enter the department in spite of my training and work up the [illegible] on account of it.

Cooperation of Our Schools

Cooperation on the part of our colleges would be helpful but is not essential. If colleges would imbue in the minds of the students the desirability of utilizing chemical knowledge in the ways indicated, so much less internal resistance would have to be overcome. The "servant to mankind and servant to industries" idea ought to disappear from the curriculum. But it does not seem probable that our institutions of learning will adopt this point of view overnight.

Not that our colleges are unmindful of the distress in which many of their graduates find themselves, but the plan that seems to be predominant among the teaching staff is to intensify the knowledge imparted to their classes and to insist on much longer and more intensive training. There are many arguments against this viewpoint, but the principal one is that if a country has reached a temporary saturation point for chemists, it necessarily finds itself in the position of a man who has just eaten a hearty meal and who cannot be induced to buy another one either by a reduction in price or by an improvement in quality.

Class Consciousness—Special Organizations—Unions

An editorial in the February, 1922, issue of the *Journal of Industrial and Engineering Chemistry* contains the following:

"Fortunately also the interests of our individual members, our Society, and the industry which we serve are identical."

Such sentiments will have to disappear if we are to accomplish anything at all. If we want to get results, we must first develop some sort of class consciousness. Measures designed to help the chemist may help the chemical industry or they may not. At any rate, the chemical industries do not seem to worry about our problems, so why should we worry about theirs?

Is it necessary to form a new organization such as advocated by CHEMICAL AGE, to rouse chemists into action? I believe not. A new society means a scattering of strength, a loss of time in building it up and a delay that may be harmful. If the majority of members in the American Chemical Society desires action on its own welfare each section could inaugurate the necessary steps within a week.

Just a few words about a union of chemists as part of the Federation of Labor. Inasmuch as a union of this kind will attract only laboratory assistants without chemical training or else graduate chemists who are temporarily doing routine work, it will never be representative of chemists as a profession. To most refined people, the thought of a union is not a pleasant one. But it should be admitted, in all fairness, that there are good arguments on both sides of this question.

Summary

Summarizing the feasible plans mentioned so far, it would seem that by regulating the number of chemical students through publicity, and by opening up new outlets for graduates through business channels, we could accomplish nearly all points that can be accomplished. The plans seem to be logical, economically correct and simple. They come up to all the specifications set up in our premises. They are fundamentally correct because they harmonize with the law of supply and demand; they work in good times as well as in bad times because they are elastic and will promote the output as chemists as well as restrict it; finally, they are of benefit to the community as a whole because they create a second line of reserve chemists whom the country can draw upon in case of emergencies and who can be released again into business channels after the emergency has passed.

Regeneration of Chromic Acid Used in Organic Oxidation

CHROMIC ACID is by far the most important oxidizing agent used for organic oxidations. The impure chromium sulfate solution containing free sulfuric acid, which constitutes the principal by-product of such operations, is usually, in practice, permitted to run to waste. Its recovery by chemical processes has not proven practicable, and although its electrolytic regeneration has many times been proposed, it is not, so far as known, commercially practiced, except occasionally as a discontinuous process.

Dr. Ralph H. McKee, professor of chemical engineering, Columbia University, has found, as the result of many experiments, that chromium sulfate in aqueous solution may be economically transformed into chromic acid by a continuous electrolytic process in which approximately 80 per cent. of the chromium sulfate content of a waste liquor is reconverted into chromic acid. The resulting regenerated solution, in which the sulfuric acid concentration is substantially the same as in the original sodium bichromate-sulfuric acid mixture, thereupon becomes available for re-use in the oxidation process, for example the manufacture of camphor, organic acids, etc.

It is a distinctive advantage of Dr. McKee's* process that it does not involve the neutralization and consequent loss of the sulfuric acid content of the waste liquors.

The accompanying diagram is of a plan view of an electrolytic cell designed for continuous flow, in which 10 represents the electrolytic cell, and 11 a porous cup or compartment, which functions as an electrolytic diaphragm, and is best made from a porous silicious material such as that known to the trade as "electrofiltros." 12 is the cathode, preferably a sheet of lead within the porous cup 11. The anodes 13, 13 are also of lead, and are disposed outside of and parallel to the porous cup, the effective anode area being preferably much greater than that of the cathode or cathodes. The inlet for the raw liquor to be regenerated is shown at 11. Its flow through the cell is as indicated by the arrows, i.e., past the cathode 12; thence into the anode compartment through pipe 15, in addition to the outflow through the walls of the cup 11; thence past the anodes 13, 13, and finally out of the electrolytic field through a siphon or other discharge pipe 16.

The liquid discharged at 16 should in a properly conducted operation be regenerated to the extent of about 80 per cent. of its original chromic acid content, although as will be readily understood a larger liquid flow may be used, and two or more of the regenerative cells may be arranged in series in the line of flow.

In the practice of the process the level of the liquid in the cathode compartment, i.e., within the porous cup in the type of apparatus shown in the illustration, is maintained somewhat above that in the outer cell, with the result that there is at all times some outflow of liquid through the cell-walls and toward the active faces of the anodes. This flow is also indicated by arrows in the diagram.

It will be understood by those familiar with this art that the primary function of the cell is to oxidize the chromium sulfate to chromium acid; and that this oxidation takes place at or near the active anode faces. At the same time the concentration of sulfuric acid tends to increase in the region of the anodes and to diminish in the region of the cathode. It is essential however that a sufficient acid concentration at all times should be maintained at the cathode, since otherwise a deposition of chromic hydroxide may occur with resulting clogging of the diaphragm. According to Dr. McKee's process the acid concentration at the cathode is maintained by the direct supply at that point of a sufficient quantity of the raw liquor, which always contains free sulfuric acid.

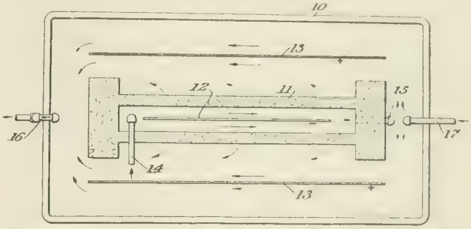


Diagram of Plan of Electrolytic Cell for the Regeneration of Chromic Acid

Since, however, the effective work of the cell is done at the anodes, it is desirable to limit the supply of raw liquor to the cathode compartment to the volume necessary for maintaining the desired acid concentration. Hence is provided a supplemental inlet for raw liquor, supplying the same directly to the anode compartment. In the diagram this inlet is shown at 17, the arrows indicating the manner in which the stream joins the flow through the anode compartment.

This, however, is not essential to the carrying out of the process, since a practical regeneration may be secured when the entire volume of raw liquor is caused to flow through the cathode compartment. It is preferable, however, to supply about two-thirds of the liquor directly to the anode compartment, the remaining one-third sufficing to maintain the proper acid concentration at the cathode.

The following data are representative of good operating practice: Current 1.0-1.2 amp. per sq. dm. anode surface; 3.0-4.0 amp. per sq. dm. cathode surface. Voltage 3.5-4.0. Acid concentration, anode, 400-600 gm. per liter. Acid concentration, cathode, above 150 gm. per liter.

The annual meeting of The American Oil Chemists' Society will be held at the Grunewald Hotel, New Orleans, May 8th and 9th, 1922. A large attendance is anticipated and arrangements are being made for entertainment, as well as the usual program of business.

* * *

Zinc production in the United States fell from 463,377 short tons in 1920 to 200,500 short tons in 1921, with a corresponding reduction in value from $78,529,000 to $21,807,000. Consumption fell from 323,043 short tons in 1920 to 203,600 short tons in 1921.

* * *

The American Chemical Society will hold its spring meeting April 3-7, at Birmingham, Ala., as the guests of the Alabama Section. Among the special addresses will be "The Pioneer's Field in Petroleum Research," by Van H. Manning; "Informational Needs in Science and Technology," by Charles L. Reese, and "Recent Developments of the Chemistry of Rubber," by W. C. Geer.

---

*U. S. Letters Patent No. 1,408,618 issued March 7, 1922.

Improved Laundry Starch

LAUNDRY starch consists usually of equal parts of wheat starch and corn starch mixed together in either granular or powder form in any suitable mixing device. Notwithstanding that equal parts of these starches are mixed together, owing to difference in the formations of particles of the respective starches and the greater hardness of the wheat starch particle over that of corn, it has been found that in shipping and handling the product, the corn starch becomes a very fine powder and the wheat starch does not break up so readily so that by the time the product reaches the consumer the larger grains of the starch have worked to the ends and around the outside of the container in which the starch is handled, leaving the powder in the center and thereby causing the separation of the two starches.

Accordingly, when this starch is used in a laundry there is no assurance that a given quantity, taken at random from a barrel, contains one-half wheat and the other half corn starch, although this was the original and intended mixture. Further, it may be stated that in the laundry business it is very necessary that the starch components should be uniformly proportioned in order that the best results may be obtained. For instance, if an over-abundance of corn starch is used the garments will be extremely stiff.

On the other hand if the wheat starch is used to excess, the garments will be altogether too pliable and flexible. It is essential therefore that the corn and wheat starches be uniformly mixed in proportions in order that the finished garments will be given the requisite appearance and character.

In view of this condition the laundry trade frequently purchases the corn and wheat starch in separate barrels and then intermingles the same when desired for use, but the objection to this system is that double quantities of the starch must be carried, and furthermore through the carelessness or indifference of the employes the proper proportions are not to be obtained.

To correct these conditions Edgar N. McVeigh combines the wheat and corn starches while they are in a state constituting a colloidal suspension in water. By this process the ingredients of the product will be uniformly proportioned throughout a given mass.

Manufacture of Corn Starch

To effect this end, the corn starch is prepared by soaking grain corn in tanks containing a weak sulphurous acid solution, in order that the hulls may be loosened from the body of the grain. These grains after being so treated are then subjected to the action of a separator, in order that the loosened hulls may be completely removed from the body of the grain. After the removal of the hulls and germs the grain is ground and is mixed with a suitable quantity of water, whereupon the resultant liquid mixture is flowed over a series of tables, in order that the excess water may flow off the starch and permit the latter to settle so that it may be collected. Upon the completion of this process the collected corn starch will constitute a colloidal suspension in water, known to the trade as starch milk, which has the consistency substantially of ordinary dairy cream and is a finished product with the exception of drying.

Manufacture of Wheat Starch

The wheat starch is formed in the usual manner by transforming wheat flour into a dough in a dough-mixer, and subjecting it to the usual washing process for the purpose of separating the gluten from the starch. When this gluten has been removed the resultant starch is passed over the settling tables which allow the excess water to pass over and to permit the remaining wheat starch to settle to the bottoms of the tables, in order that the starch may thus be collected and dried.

Blending

Hitherto it has been an uncommon practice to dry these different starches in a separate state in order that they could be reduced to a granular or powdered form, and then mechanically mixed, as above stated, for trade purposes. However, to overcome the above stated disadvantages, Mr. McVeigh* puts these two starch creams in equal amounts in large tanks, equipped with agitators, in which they are thoroughly mixed.

After being thoroughly mixed in their semi-liquid condition, the starches form a composite product which is withdrawn from the tanks and is put through the regular drying process used in drying the starches separately. When the starch has been finally dried it assumes a granular form, each grain and particle containing one-half wheat and one-half corn combined into a mechanically inseparable whole, which thereby assures the user a uniformity which can not be obtained by the prior methods described.

Blending the two liquid starches before drying is capable of producing a more uniform product than it is possible for the laundryman to make in his own plant. The process has the added advantage of enabling the user to cover his starch requirements with one barrel of starch instead of two, and also results in a saving of the labor of mixing and the possibility of errors in preparation, which is a very important item in this particular business.

Principal Ingredients of Margarin

The kinds and quantities of the principal ingredients used in the manufacturer of margarin, according to the U. S. Food Administration for the fiscal year 1918 and to the Bureau of Internal Revenue for the fiscal year 1921, are as follows:

Ingredients	Lbs. 1918	Lbs. 1921
Cocoanut Oil	61,773,000	103,111,916
Corn Oil	60,000	925,999
Cottonseed Oil	36,454,000	18,532,860
Peanut Oil	21,593,000	16,332,498
Butter	4,548,000	1,498,625
Neutral Lard	45,702,000	29,267,960
Oleo Oil	96,378,000	49,675,749
Milk	61,128,000	79,715,584
Salt	18,279,000	25,365,499

In a bill recently reported by the House Committee on Agriculture provision is made for increase of salaries to several scientists of the Department, among which is the chief of the Bureau of Chemistry which is sought to be advanced from $5,000 to $6,000. The Department has been embarrassed for years by the superior financial inducements of private interests, taking away from it scientific men because they can not afford to continue working at the poor pay allowed by the government. The bill is intended to remedy in part this situation.

---

*U. S. Letters Patent 1,406,058 issued February 7, 1922, and assigned to Keever Starch Co., Columbus, Ohio.

Personal Items

Howard T. Graber, director, chemical laboratory, Digestive Ferments Co., Detroit, Mich., has been elected secretary of the company.

* * *

A. P. Gest, Jr., formerly assistant superintendent of the Frankford, Phila., plant of The Barrett Co., is now with Keator & Wilson, Philadelphia.

* * *

Harmon F. Fisher, formerly in charge of U. S. Government helium plant No. 3, Petrolio, Texas, is now in the research division, American Petroleum Institute.

* * *

Harold E. Martin, formerly in the research department, General Chemical Co., is now in the insulation and power plant specialties department of Johns-Manville, Inc., New York.

* * *

George T. Southgate, formerly research engineer, American Cyanamid Company, at Brewster, Fla., is now with the Bureau of Soils, Department of Agriculture, Washington, D. C.

* * *

William Drew, of the former Marden, Orth & Hastings organization, and later manager New York office, E. R. Smead Co., is now with the Falk Co., Pittsburgh, Pa., as assistant to Vice-President A. C. Trask.

* * *

H. B. Prior, for the past 12 years with the Grasselli Chemical Co., has resigned, effective March 1, to conduct a sales agency and commission business in acids and chemicals at No. 17 East 42nd Street, New York City.

* * *

R. G. Sherwood has been made director of inspection, Corning Glass Works, Corning, N. Y., in which department will be centralized the work of 4 departments, viz.: pyrex and miscellaneous ware, railroad and marine ware, bulbs, and electric tubing and cane.

* * *

Dr. Henry H. Rusby, Dean of the College of Pharmacy, Columbia University, who was compelled by sickness to relinquish his leadership of the Mulford biological expedition in the Amazon Basin, has returned to his home at 776 De Graw Avenue, Newark, N. J.

* * *

Morgan Wing, for many years secretary and director of Wing & Evans, Inc., whose resignation was effective October 1, 1921, has reorganized and become president of the Robert Wrench Co., Inc., of 71 Murray Street, New York, N. Y., manufacturers of the self-adjusting Robert Wrench.

* * *

David W. Jayne and Herbert G. Sidebottom, respectively manager of the chemical department and of the technical sales department of the Barrett Co., after long service, have severed their connection to engage in independent business, as Jayne & Sidebottom, Inc., sales agents of manufacturers of chemical products at 17 Battery Place, New York.

* * *

Clayton L. Jenks, for 6 years assistant examiner U. S. Patent Office, and who organized and conducted the Eastman Kodak Co., patent department, has established an office at 2 Rector St., New York, for independent patent practice, in connection with the conduct of the patent department of the Norton Co., Worcester, Mass., which he organized 5 years ago.

Burt G. Shields has been appointed assayer, U. S. Assay Office, New York City, to succeed George R. Comings, deceased.

* * *

Burt H. Goddin, sales manager Hoffman-LaRoche Chemical Wks., New York City, has been appointed health commissioner of Bogota, N. J.

* * *

Dr. Victor F. Hess, technical director, U. S. Radium Corp., 58 Pine St., New York, has been appointed consulting physicist, U. S. Bureau of Mines.

* * *

L. J. Buck, formerly of the National Carbon Co., a subsidiary of the Union Carbide & Carbon Corp., has been appointed U. S. sales representative of the British American Nickel Corp., 342 Madison Ave., New York.

* * *

Dr. Charles Russ Richards, dean of the College of Engineering of the University of Illinois, has been elected president of Lehigh University to succeed Dr. Henry S. Drinker, who resigned in January, 1920, and is now president emeritus.

* * *

R. J. H. de Loach, director, bureau of agricultural research, Armour Fertilizer Works, will demonstrate successful methods of cotton cultivation under boll-weevil conditions on a 5,000-acre farm at Arlington, Ga., during the coming summer.

* * *

C. L. Bryden, 95 Liberty St., New York, eastern representative Vallez rotary filter press, on March 1, addressed the students of the course in chemical engineering, Sheffield Scientific School, Yale University, on "Filtration and the Filter Press."

* * *

Hollis H. Dunn, formerly of Experimental Station, E. I. du Pont de Nemours & Co., and latterly engaged in sugar chemistry in Cuba, is now with the Darco Corp., Wilmington, Del., as technical assistant to the sales manager in sales promotion in the sugar industry.

* * *

Edward Bartow, head of the department of chemistry and professor of sanitary chemistry, Iowa State University, Iowa City, Ia., has been proposed as national vice-president, American Association of Engineers by its Sioux City chapter. Prof. Bartow also is president of the American Waterworks Association.

* * *

Dr. J. A. Ambler, acting chemist-in-charge of the color investigation laboratory, Bureau of Chemistry, U. S. Dept. of Agriculture, announces the completion of his compilation of American dye patents and the increased service of the color investigation laboratory in patent research in this field.

* * *

Frederick Kniffen, for the past 15 years in charge of the manufacturing activities of E. I. du Pont de Nemours & Co., in its cellulose products department, as the result of an administrative reorganization of this department, has been granted a well-earned respite from active duty. He will act in an advisory capacity in a leisure that will permit independent work. In this reorganization, M. V. Hitt has been made manager of the Parlin, N. J., plant, succeeding J. W. Elms who becomes division manager of the chemical products division, located at Parlin. H. J. Haon is made manager of the Newburgh, N. Y., fabricoid plant. E. R. Cathcart continues as superintendent of the Fairfield, Conn., rubber fabrics plant.

Industrial Notes

The Atlas Powder, Wilmington, Del., contemplates the erection of a $2,000,000 powder plant at Pinckneyville, Ill.

* * *

Eastman Kodak Co., common stock has been changed from 250,000 shares par $100, to 2,500,000 shares of no par value.

* * *

The Precision Thermometer Corporation, New York, has leased a floor in the building at 222 East Forty-second Street for local works.

* * *

W. L. Fleisher & Co., engineers, 31 Union Square, West, New York, have leased the two-story building, 50 x 150 feet., on South Washington Place, Long Island City, for a mechanical works and laboratory.

* * *

In pursuance of its plan to concentrate dye manufacturing operations at its Buffalo plant, National Aniline & Chemical Co., Inc., has about completed the transfer of the equipment of its Brooklyn plant to that place.

* * *

The General Electric Co., Schenectady, N. Y., has acquired about 24 acres at Oakland, Cal., as a site for a new plant, to cost about $1,000,000. It will be operated in conjunction with the lamp manufacturing plant at West Oakland.

* * *

The Research Corporation, 31 W. 43rd St., New York, will install a Cottrell electrical precipitation equipment in the U. S. Assay Office, New York City, to recover gold from fumes, experiments having indicated that considerable saving is possible.

* * *

The International Nickel Co. will close one of its Bayonne, N. J., plants, the equipment of which will be distributed among its new plant at Huntington, W. Va., its refinery at Port Colborne, Ont., and another Bayonne plant which will continue operating. Experts have been engaged to broaden the field for nickel and monel metal parts. In the past most of the nickel has gone into armament and war material, but, because of the agreement to reduce war ships and armament, there will be a substantial reduction in the use of nickel for these purposes. The industry, therefore, is facing an entirely new condition where new uses will have to be forthcoming to make the industry a success.

* * *

The Keystone Carbonic Gas Co., Connellsville, Pa., recently organized, has acquired the plant of the Highspire Distillery Co., Highspire, Pa., for the manufacture of industrial gas. T. B. Donnelly is vice-president, and E. W. Powell, secretary, both of Connellsville.

* * *

The National Filter Cloth & Weaving Co., 57 Hope street, Brooklyn, manufacturer of wire cloth, is having plans prepared for a one-story brick plant, 70 x 200 ft., on property recently acquired at Hamden, Conn. Equipment will be installed for the employment of about 100 operatives.

* * *

The plant of the Nashville Pulp & Paper Corp., using southern pine as raw material, which comprises a portion of the guncotton unit of the Old Hickory munitions plant near Nashville, Tenn., will soon be ready for production. A finished paper mill will be installed. R. J. Callen is president and general manager.

The Hardinge Co., 120 Broadway, New York, has acquired the business of the Coal Washing Equipment Co., Pittsburgh. The Coal Washing Equipment Co. did not have its own factory, its equipment being made in other shops on a contract basis, but the Hardinge Co. will now manufacture this equipment in its own plant at York, Pa.

* * *

The Air Reduction Sales Corp. has purchased all the assets, including patents and trade marks, of the Davis-Bournonville Co., Jersey City, N. J., pioneer and largest manufacturers of all lines of oxy-acetylene apparatus. Its manufacturing and sales organization will be amalgamated with that of the Air Reduction Sales Corp., 342 Madison Ave., New York.

* * *

The decision of the U. S. Supreme Court declaring confiscatory the New York statute of 1906 fixing the price of illuminating gas at 80 cts. per 1,000 cu. ft. is of far-reaching importance as relates to the service of public utilities. The hamstringing of public service corporations by politicians who, to gain votes, would restrict their power to serve by making impossible their operation at a profit, has been rebuked, with the result that henceforth more equitable treatment may be expected in their public regulation.

* * *

The action for infringement of the Ganz patent, which is the basis of the zeolite water softening process of the Permutit Co., 440 Fourth Ave., N. Y., brought by the latter against the Refinite Co., Omaha, Neb., resulted on appeal to the U. S. Circuit Court of Appeals at Buffalo, N. Y., in a decision in favor of the Permutit Co. In the decision it is declared that "the apparatus of the patent in suit produced a new result in the art, for which chemists had sought in vain for half a century. This inventive thought has been applied industrially and has resulted in the production of 'zero' water for the first time. Its commercial success has been great. It is a new and useful result obtained by the use of a new apparatus, although in the construction old elements have been used. This entitles the inventor to the protection of a patent."

POSITIONS WANTED

MANAGER, Chemical Engineer, University graduate, thirty-five years of age, single, experienced in the operation and management of plants, desires to make a change offering a broader field of development. Best of references given on request. Address C-3, care of CHEMICAL AGE.

CHEMIST-SUPERINTENDENT: Canadian (32), fifteen years' experience as general analytical and consulting chemist wishes to make change. Mineralogical, metallurgical, alloys, fuel, fertilizer, etc., analysis; superintendent corn oil refinery; some chemical engineering. Now employed as chief chemist with corn starch and glucose plant. Will go anywhere. Address "Canadian," care of CHEMICAL AGE.

FOR SALE

FOR SALE: One new Patterson Pebble Mill, Style F, 12 x 10 complete, including one ton of French pebbles. Substantial reduction in price. Basic Chemical Corporation of America, 77 Seventh Avenue, Brooklyn, N. Y.

CHEMICAL
AGE

A CONSOLIDATION of THE CHEMICAL ENGINEER and CHEMICAL AGE

LLOYD LAMBORN, *Editor*

VOLUME 30 NEW YORK, APRIL, 1922 NUMBER 4

The Forest Products Industries of the South

A Warning of Disaster and a Plea for Remedial Measures. The Role of Chemistry in the Conservation of Its Timber Resources.

By Carlile P. Winslow

Director, Forest Products Laboratory, Forest Service, U. S. Department of Agriculture

CARLILE P. WINSLOW

Director, Forest Products Laboratory, Forest Service, U. S. Department of Agriculture.

THE original timber stands of the South aggregated 650 billion board feet and occupied an area of 125-130 million acres, or nearly 50 per cent. of the total area of the Southern States. It was looked upon as an inexhaustible supply, a viewpoint similar to that which existed in the earlier days in New England, and later in the Lake States. In these regions, for some years, lumber operations flourished to an extent previously undreamed of nationally, and it was only with the falling off in production, first in New England and later in the Lake States, that the development of the Southern pine forests really began on a large scale.*

This was in the early nineties, and since then until quite recent years the production in this quarter continued to increase annually until it represented the bulk of the annual production of lumber and forest products in the United States. In 1909 it reached the peak of production with an annual cut of 16 billion feet, which represented nearly one-half of the entire country's cut of softwoods. While it has fallen off since then, it still amounts to 11 billion feet and is the most important single factor of any region in our lumber production. Its products are valued at 310 millions dollars annually, and the industry and its allied activities in the South Atlantic and Gulf States from North Carolina to Louisiana give employment to one-quarter million wage earners. This is about 42 per cent. of the South's population employed in industry, and varies in the different States about as follows: Georgia, 33 per cent.; Alabama, 40 per cent.; Florida, 61 per cent.; Louisiana, 66 per cent.; Mississippi, 79 per cent.

The foregoing very briefly presents the situation up to the present time and shows that lumber production in the Southern States, although smaller than it has been for a few years past, is still in the lead and aggregates an enormous amount. It would be pleasant and satisfying could we complacently assume that this situation as it is today could be continued perpetually, but such is not the case.

A recent survey of sawmills owning or controlling practically the entire remaining virgin yellow pine stand in the South indicates that nearly 82 per cent. will be cut out in 5 years or less, and the annual output of lumber will be correspondingly reduced by nearly 50 per cent.; 97 per cent. will be cut out in 10 years, with a corresponding reduction in output of 78 per cent.; and in 20 years all mills except 12 will be cut out and their production will have been reduced to only 3 per cent. of the 1919 output.

Reforestration Imperative

This is both a startling and serious situation. While operations on second-growth material will undoubtedly affect the annual production to an important degree, it is not unreasonable to forecast that within the next 15 years or less the annual production will be only one-half, or possibly less, than at present; in 20 years it can be expected to be diminished further. At the present time, approximately one-third of the cut in the South is used for domestic purposes and the remainder shipped to other parts of the country. Within 10-15 years or less, with the growing demands for timber in the United States, it may well be that Southern lumber production will be sufficient only for its own needs—and shortly thereafter insufficient even for this. It then will be necessary for the South with its original great forest resources and its remarkable possibilities for forest growth, to bring in timber for its own use from the west and northwest regions of the United States.

---

* From address at Birmingham meeting, American Chemical Society, April 4-8, 1922.

Facts and tendencies as outlined above, however regrettable, are nevertheless clearly evident to all those who have studied the situation, and they must be reckoned with. "As ye sow, so shall ye reap;" nothing can now be done which will prevent a very decided falling off in lumber production in the South for a period of years. If nothing is done, this falling off will be of a yearly increasing character until the production becomes so slight as to be an insignificant factor. On the other hand, thought and action at the present time will enable much to be done to meet the situation, and to insure at least a fair amount of timber for that region in the future. There is, in the first place, an area of 100 million acres of cut-over lands, which is rapidly increasing as the timber is cut each year. While much of this is suited for agriculture and will undoubtedly be developed for that purpose, there are many million acres which are best adapted for timber growth.

Climatic and labor conditions of the region are such that timber can be grown cheaper than in any other part of the country. To handle cut-over lands and to direct future cuttings with a view to reproduction, to take measures to protect the abundant natural reproduction from fire and the hog-grazing nuisance, are measures which, if applied would do much to help the situation. Already the Great Southern Lumber Company at Bogalusa, La., has undertaken the reforestration of certain areas; and here in Birmingham the Kaul Lumber Company is active along the same lines. This company now feels that its former practice of clean cutting without regard to reproduction and perpetuating its holdings by annual growth was greatly in error.

These are encouraging signs, and in such a region with an almost unlimited quantity of land suitable for the growth of timber and more or less unsuitable for other purposes, with conditions more favorably adapted to rapid and luxuriant growth than in any other part of the country, and with the need of timber such an important factor, not only to the industrial and economic welfare of the South but to the nation as a whole, it seems impossible, in fact, unthinkable, that something can not be done, either nationally or privately, or by the States, or by all three combined, to meet the situation effectively.

It is, of course, obvious that one of the most striking elements in the question of providing future forests is whether or not it pays to grow timber for commercial purposes. If it once can be established that such is the case and that the profits are sufficiently sure and sufficiently large that capital will be attracted, then it is certain that an adequate timber supply for the future will be assured. Capital, we all know, is timid. It does not like to venture into an unknown field with many hazards for loss and only slight chances for success. I confess a sympathy for this viewpoint. I am sure that if I had capital I would feel the same way. It is of the utmost importance, therefore, both locally and nationally, to do whatever may be possible to make the growing of timber a profitable venture.

One method of accomplishing this object is to add to the value of the timber when grown. If ways and means can be developed to utilize more effectively all the material grown instead of losing from one-half to two-thirds as is the case under present operations, it would undoubtedly add to the value of stumpage. There are many possibilities along these lines, some already more or less developed and more or less successful, and others still awaiting further exploration and development.

Research Needed

What is first needed is well-directed research aimed at the solution of certain problems which prevent or retard the economic success of certain possible by-products of the lumber industry. It is really astounding that the timber owners of the South, with their gigantic holdings and the enormous potential value of their material, have failed to grasp the importance and value of research along these lines. I shall attempt to point out briefly a few of the more important industries dependent on the forests and what may be hoped for in the future with changing economic conditions and successful progress on the research and technical phases of some of the problems.

Turpentine and Rosin from Gum

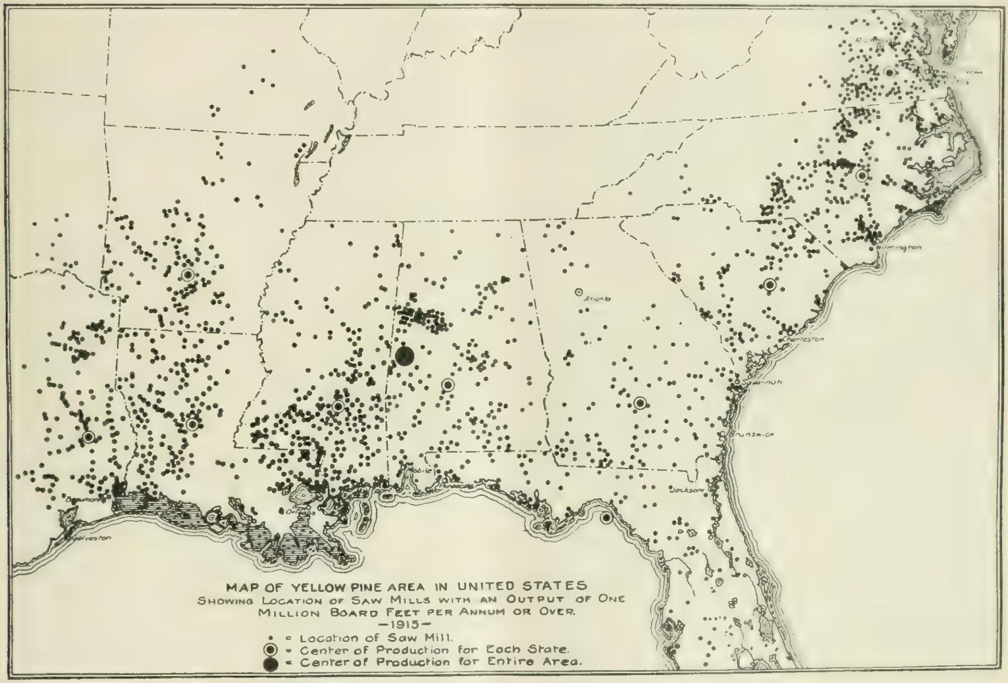
A conspicuous example of a well-established and nationally important industry dependent almost entirely upon the pine forests of the South is the naval stores industry. Since the Civil War this industry has held a place among the industries of the South inferior only to agriculture and lumber. It gives annual products valued in excess of $46,000,000, more than half of which are exported. The production of naval stores from this region amounts to from 75 to 80 per cent. of the world's production. France produces about 14 per cent. and the balance is made up from Spain, Portugal, Greece, India, and miscellaneous sources.

It is possible that France may to some degree increase its production, and it is said that there are some possibilities in Germany and even in Russia some years hence, but none of these offer the luxuriant supply or possibilities which have existed and still exist in the South. We are, however, facing a serious situation in that quarter. Most careful opinions and estimates indicate that there are not more than 31,000 crops of turpentine timber available and uncupped in the southern naval stores territory today. From this amount, it is estimated that not more than 166,000,000 gallons of turpentine, and 5,000,000,000 pounds of rosin, can be produced. In addition to the uncupped supply of timber, that which has been or is now being worked will probably yield 60,000,000 gallons of turpentine and 1,900,000,000 pounds of rosin, making the total available supply 226,000,000 gallons of turpentine and 6,900,000,000 pounds of rosin.

Our own markets and export demands will probably absorb 25,000,000 gallons of turpentine and 825,000,000 pounds of rosin annually. At this rate, the supply of timber now in sight would be exhausted in less than 10 years. This will actually be extended beyond this period by the production of wood turpentine and rosin and also by the gradual falling off in the rate of production as the remaining timber supplies become exhausted. The indications are, however, that the production of gum naval stores of the southern pine belt will within 10 years have been reduced to such an extent that export markets and hence our own must look elsewhere for their main supplies.

It may be that this situation can be met partly by the stimulation and growth of the industry in the forest countries mentioned above. Possibly it can be helped further by development in Mexico and Central America. Possibly it may be materially helped by the development of the industry on the West Coast from pine and fir. But it is known that none of these other sources or species or possibilities will furnish a supply so readily, or so cheaply, as the southern pine, and it is improbable that this country can by any means keep its leading position unless measures are taken to preserve this industry on a flourishing basis in the South.

We know now that the virgin timber available for this purpose will be largely cut within a 10-year period; we know that second-growth material is becoming available and will become increasingly available in the next decade and later; and we also know that how to harvest the naval stores crop from such material is still an unknown factor. To handle the situation efficiently it is necessary to know the minimum age or size timber which can be tapped, the severity, extent, and character of the chipping necessary, and methods of operation which will permit the greatest production of naval stores from a given tree over the longest period with the greatest economy and least injury to the ultimate use of the timber for saw logs. Properly directed research should be undertaken on a comprehensive scale to secure the necessary knowledge in advance of the calamity which we are facing.


MAP OF YELLOW PINE AREA IN UNITED STATES
Showing Location of Saw Mills with an Output of One Million Board Feet per Annum or Over.
—1915—
• = Location of Saw Mill.
◉ = Center of Production for Each State.
● = Center of Production for Entire Area.
Wilmington
Atlanta
Charleston
Savannah
Brunswick
Jacksonville
Mobile
Orleans
Galveston

Courtesy of Jos. H. Wallace & Co., Industrial Engineers.

Turpentine and Rosin from Chips

Closely allied with the general naval stores situation is the production of turpentine and rosin by steam distillation and extraction from chips. The turpentine produced from this source is equal in grade and quality to the turpentine produced from gum. While the rosin so produced has not yet, on a commercial basis, equaled in purity and color the best grades of gum rosin, it is believed that with further research and development of improvements in the process a rosin equal to the gum rosin can be produced. At all events the production of turpentine and rosin by this process aggregates about 10 per cent. of the total from all sources and six well established commercial plants are in operation in the South. Several more, built during recent years, are at present shut down, but it is felt that this is a temporary situation which will change as prices for these products improve with improving general business conditions. In fact, I think that we may safely look forward to a growing expansion of this industry, and it will undoubtedly will have an important bearing on the total southern naval stores production.

We must recognize, however, that the source of the material is stump wood from the cut-over resinous timber areas, and however much the industry may be expanded and however successful it may be in the production of satisfactory products at reasonable costs, the source of supply of stumps will not last indefinitely. Sooner or later, unless timber is grown, the stumps available will become exhausted and hence the possibilities of meeting the situation permanently in this industry are limited. It may aid the situation, or in fact save it for a period of possibly 15 or 20 years, or possibly 30 years, or possibly longer, but that it can not save it or aid it indefinitely is indisputable. It may be the means of tiding over a situation until the second growth material is available in sufficient quantities for satisfactory turpentine operations, but unless provision is made for an ultimately adequate supply of such second-growth material, these industries will eventually permanently shrink to a more or less insignificant scale.

Wood Chemical Industry

Destructive distillation of woods is another industry which may be expected to expand along certain lines.

Distillation of resinous woods produces charcoal, turpentine, pine oil, acetic acid, and a large quantity of tar. The quantity of acetic acid is relatively small or insignificant. The turpentine is not equal in grade and quality to the gum turpentine and the products and by-products which can be chemically produced from the tar have never been thoroughly determined nor have markets been developed for their uses. There are at present about 8 commercial plants in operation in the South and a large number of smaller plants which operate more or less intermittently, according to the market conditions. Until the tar products have been developed and given an established commercial position it is not believed that this industry will expand to any very great degree.

With hardwoods the situation is somewhat different. Here the main products are wood alcohol, acetic acid and charcoal. Prior to the war there were only two hardwood distillation plants in operation in the Southern States. It is notable, however, that the additional plants built to meet the war-time demands were all established in Southern States, and the probabilities are that the future growth of that industry will be in that region. The diminishing hardwood supply throughout the country is such that the hardwoods, particularly oak, lying to the south of the Ohio River, are becoming increasingly important as a source of supply, not only to the wood distillation industry but to others.

Pulp and Paper

A field which in the past few years has been receiving attention and promises important developments is the production of news print paper. The population of the 15 Southern States aggregates 32½ million, and it is roughly estimated that the annual consumption of news print paper aggregates 30 pounds capita. This means a daily output of 1,600 tons of paper and the consumption of approximately 2,000 cords of wood per day. Practically all of this paper is brought into the Southern States from other sections of this country or Canada.

It comes from localities where wood is more expensive and where wood will continue to be more expensive because the South can grow timber more cheaply than any other part of the United States. It involves a freight charge varying in amount according to source but nevertheless amounting to an appreciable factor in the net cost to the community. Why is it not possible for the South to produce its own news print paper? Cheap power is required, but the South has cheap water power and cheap coal, and should be able to meet this requirement. It has relatively cheap wood, and will continue to have it if attention and care is given to providing it.

It may be said that the bulk of this material is too resinous to produce pulp which can be handled satisfactorily over the paper machines. This may be true under the processes which have been developed to suit spruce and other woods free from resin, but it does not mean that methods can not be found or developed for preparing or treating such resinous woods so that this difficulty may be overcome. Chemists conversant with a situation are optimistic that sooner or later research along these lines will give the answer.

A hopeful and encouraging sign of present tendencies is the action taken not long ago by some far-seeing men in Birmingham. Spruce pine, which occurs in considerably large quantities in Alabama and which is less resinous than the longleaf pine, was made into groundwood pulp on a commercial scale, and with the requisite amount of sulphite pulp made into finished news print. The work was done at Niagara Falls, and I am advised that no difficulties were experienced from the rosin on the paper machine. Unfortunately, the quantity was only sufficient to operate the paper machine for a few hours, and a longer period is required to prove definitely whether or not pitch difficulties would result.

With the amount of wood of this character and also cheap water power available in Alabama it is hoped that the experiments may be again resumed and carried forward to a finally conclusive point. Sulphate pulp now made satisfactorily in a number of mills in the South could be combined with such groundwood in making the finished news print paper and such a development should prove the entering wedge to the development of a real news print paper indutsry in the Southern States.

That available southern woods may be utilized satisfactorily for the production of book and magazine paper is now an established fact. Tests completed at the Forest Products Laboratory, within the past year, have shown how gum and southern pines may be cooked by a modification of the sulphate process so that they may be economically bleached to a satisfactory color in book and magazine stock. The results of this work are conclusive in showing that this is now a practical possibility, and as industrial conditions improve in this country I look forward to seeing an industrial development along these lines in some of the Southern States.

The production of wrapping paper and container board liners by the sulphate process using southern pine is and has been an important industry for a number of years. Thirteen plants in the Southern States now produce annually approximately 95,000 tons of such pulp. Woods and mill waste in one form or another are utilized to some extent for this purpose and with the general diminishing supply of timber throughout the country, such use may be expected to increase. Here also I wish to refer again to the steam distillation and extraction process for producing turpentine and rosin. Laboratory tests have shown these extracted chips to be entirely satisfactory for the production of sulphate pulp provided always that the wood is chipped with a view to utilization after extraction for this purpose. Present commercial methods of chipping for extraction do not produce a chip satisfactory for pulping. An operation combining extraction and pulp plans should result in considerable economy.

Ethyl Alcohol from Wood

In attempting to increase the value of stumpage by close utilization of material, more or less wasted under past and present conditions of operation, methods offering promise for the utilization of mill waste and sawdust naturally attract first consideration. The production of ethyl alcohol from this source is one to which much thought has been given and some success attained. The hydrolysis of wood, using a weak solution of sulphuric acid as a catalyzer and thereby changing some of the cellulose into a fermentable sugar long has been known as a promising process. Much time and money have been expended within the past 12-15 years in efforts to establish it on a commercial basis.

It has been shown that southern pine is suited to such use and that approximately 20 per cent of the dry weight of the wood hydrolyzed can be converted into fermentable sugars. Two commercial plants, one in South Carolina and one in Louisiana, have been installed and were in successful operation particularly during the war period. They had a united daily production of approximately 7,500 gallons of pure ethyl alcohol until recently when, due to a curtailment of operations by the lumber mill with which it was connected, the Louisiana plant closed down.

It is unfortunately true that under present prices in the molasses market, which permits an alcohol production from this source at a cost probably not exceeding 16-17 cents per gallon, ethyl alcohol from wood waste can not be produced at a cost low enough to compete, and this industry is receiving at least a temporary setback. It is evident, however, that if the cost can be sufficiently reduced the process offers an opportunity for very wide development. Theoretically from 2 to 3 times as much alcohol might be produced per unit of material as is possible under present operating methods. If further research can determine how to increase the yields to approximate more closely this theoretical limit, it is not at all unreasonable to conceive of a lower production cost per gallon which will insure the further expansion.

Closely related is the possibility of the utilization of the hydrolyzed sawdust and fermentable sugar for cattle food. Feeding tests conducted by the University of Wisconsin in co-operation with the Forest Products Laboratory have shown that for dairy cattle this material may be substituted for grain to furnish the necessary carbohydrates. This possibility is being tested further. It offers another hopeful opportunity for effective utilization of sawdust and mill waste, particularly in regions into which grain must be imported from other sections of the country.

Timber Preservation

An industry closely allied with the timber and lumber operations is that of wood preservation in which chemicals, such as zinc chloride and creosote oil, are used as saturants. The material treated at present comprises chiefly railroad ties, piling, bridge timbers, posts and poles and, to some extent, mine timbers. It is an important industry, in the Southern States particularly, because of climatic conditions favorable to decay. Of the 125 wood preserving plants in the United States, 41 are located in the Southern States. Approximately 800,000,000 bd. ft. of timber were treated in these plants in 1920. Within reasonable limits and in relation to the normal growth and development of the country this industry may be expected to gradually expand both nationally and in the South. Shortage of timber supply means, in the long run, high prices, and the more costly the wood becomes the more it becomes necessary to give it artificial treatment to prolong its life and service.

As a general rule it may be said that thorough preservative treatment doubles the average life of timber. In other words, the application of preservatives to all the wood in this country which is used under conditions which favor decay would enormously decrease the drain on the timber supply. Decay destroys more timber each ear than any other destructive agent. Timber preservation is therefore one of the most important means available for the conservation of forests.

Common Sense—and Fertilizer Manufacture at Muscle Shoals

By Walter S. Landis

Chief Technologist, American Cyanamid Company; Past President, American Electrochemical Society

THE possibilities of commercial operation of the U. S. Nitrate Plant No. 2, which was designed and constructed under supervision of the Ordnance Department of the Army by Air Nitrates Corporation, a subsidiary of the American Cyanamid Company, for the purpose of producing ammonium nitrate, a war explosive, is today a subject of much public discussion.[1]

The Muscle Shoals Nitrate Plant is one of the largest war undertakings ever executed in any country. Its operation begins with a limestone quarry. There is plenty of quarry capacity in Alabama now in existence. The stone is burned to lime and then mixed with coke and converted by electric furnace smelting into calcium carbide. The producing capacity of the Muscle Shoals carbide plant greatly exceeds the consuming capacity of the country, without regard to the available capacity of the several plants already specializing in this product.

The carbide is transformed into crude cyanamid, which material of itself has no direct use except for conversion into other materials. This is not the cyanamid product found on the market as a fertilizer ingredient, and the plant is not equipped to transform it into such fertilizer form.

Ammonia

At Muscle Shoals the crude cyanamid is converted by suitable processing into ammonia gas—as such an unmarketable material. Part of the ammonia gas is oxidized into nitric acid and recovered in a dilute form. No provision is made in the design and equipment of the plant for converting this dilute nitric acid into the marketable forms; and even if so converted the distribution to points of consumption would present almost insurmountable difficulties. The remainder of the ammonia gas is absorbed into this dilute nitric acid forming a solution of ammonium nitrate which is then evaporated and grained.

Ammonium Nitrate

Ammonium nitrate is the sole product for which this plant was designed and built. The importance of this compound in the munitions field is well known. In peace times it has a market in this country to the extent of about 20,000 tons maximum, and is produced by the high explosive manufacturers from their waste acids and by-product ammonia. It enters into the manufacture of industrial explosives; but the explosive makers could never afford to take the product of Muscle Shoals in place of their present product made from waste materials and which costs them but a fraction of the cost of producing this material at the Government Nitrate Plant.

The only additional outlet for the ammonium nitrate that might be considered is the fertilizer industry. Ammonium nitrate, however, is not only very much more costly to produce than other forms of nitrogenous fertilizer material but has physical and chemical properties that make it entirely unsuitable in ordinary fertilizer practice. It is extremely hygroscopic and unfit for handling either by the farmer or in the fertilizer mixing-plant. When mixed with other common fertilizer materials it releases and loses some of its nitrogen in the form of poisonous gases. Suggestions have been made for combining ammonium nitrate with other salts for fertilizer use, for example, with ammonium sulphate. In any such mixture, however, ammonium nitrate seems to remain an explosive, as witness the recent destruction of a portion of the plant at Oppau, Germany, occasioned by the explosion of such a mixture.*

Recognizing, therefore, the impossibility of commercial operation based upon ammonium nitrate, the students of the problem directed their attention to two other materials, viz., cyanamid (the fertilizer variety) and ammonium sulphate. The manufacture of either of these two materials would utilize only a portion of the manufacturing plant proper, representing in value about half that of the whole manufacturing plant. That portion devoted to manufacture of nitric acid and ammonium nitrate would not be used in the production of these two materials.

To transform crude cyanamid into the form suitable for fertilizer use it would be necessary to install a plant for its complete hydration and dust control. To produce ammonium sulphate it would be necessary to install a complete absorption and drying plant. For either material, enormous storage, bagging and shipping facilities must be provided, since the fertilizer industry is seasonal. In all probability, instead of purchasing the 220,000 tons of sulphuric acid required per year, if sulphate is the product, it would be found advisable to erect a separate sulphuric acid plant. The additions of such facilities would add millions in plant investment.

The entire American market for cyanamid in the year of maximum consumption was approximately 40,000 tons, or less than one-fifth of the capacity of the Muscle Shoals Plant. This entire market is now fully supplied by the American Cyanamid Company from its plant at Niagara Falls, Canada, operating on primary power fully as low in price as the Army Engineers estimate would be the cost of primary power at Muscle Shoals. Assuming that proper overhead charges would be included, the cost of producing this cyanamid at Muscle Shoals would be in excess of the cost of producing at Niagara Falls.

It is not conceivable that any operation at Muscle Shoals would do otherwise than drive the market price down to a point lower than its cost of production; because the market for cyanamid is strictly limited by the fact that only a small quantity, approximately 60 pounds to the ton of mixed fertilizer, can be used. Under American agricultural practice the use of cyanamid for direct application to the soil has not been found feasible.

Sulphate of ammonia, which enters into the fertilizer industry to the extent of 150,000 tons in a normal year with possibilities of increase as the indutsry grows, has been given more serious consideration than any other material as a commercial product for the Muscle Shoals Plant. The trouble with this proposed manufacture, however, is that it will cost more to produce sulphate of ammonia at Muscle Shoals than the present or prospective wholesale market prices. All the sulphate of ammonia at present entering into the American fertilizer industry is produced as a by-product of the coking of coal. The American Cyanamid Company was at one time engaged in the manufacture of sulphate of ammonia by way of cyanamid ammonia, but gave up this manufacture because it could not compete with the product of the coke ovens. That was at a time when sulphate of ammonia was selling as high as $100 per ton, whereas the average market price for the past year has been approximately only $50 per ton.

Prior to the War (1914) the American production of ammonia was equivalent to 183,000 tons of sulphate of ammonia and American consumption in that year was 272,000 tons; but in 1920 we produced approximately 515,000 tons, consumed in this country 320,000 tons, exported 130,000 tons, and carried over the remaining 55,000 tons as a surplus. From dependence upon Great Britain and Germany to supply us with a part of our ammonia requirements, we have been transformed by the enormous expansion of the byproduct coke-oven industry during the war into one of the greatest ammonia-exporting nations of the world. Meanwhile the price has dropped to a point representing about two-thirds the cost of manufacturing this material at Muscle Shoals.

A multitude of suggestions as to other possible commercial products of the Muscle Shoals plant are cropping up continually. Some of these would use little or none of the equipment as at present installed, and would require changes of such character as to destroy the potential nitrogen-preparedness value of the plant. Others relate in general to organic and fine chemicals of such extremely small consumption as to warrant no consideration in any manufacturing plan for so large a plant. Still others are incapable of economical manufacture in the nitrate plant at Muscle Shoals.

The outlook for an immediate commercial operation of the Muscle Shoals Plant is, therefore, extremely discouraging. It is a war plant built to furnish a specific war requirement. That requirement disappeared with the signing of the Armistice, and we have not yet found a commercial peace-time outlet for the products of the kind and quantity that the plant may be adapted to make.

We all hope a commercial use for this plant may be found, but we are not in sympathy with any proposal that involves subsidized operation, disregard of all relationship between costs of production and selling prices, or destructive Governmental competition with private industry in which we share the sound opinion of all who believe that the sole business of government is to govern. The American people can rest assured that private industry will continue to give the closest attention to developing every possibility that might lead to a future peace-time operation of the Muscle Shoals Nitrate Plant on a fair, unsubsidized commercial basis.

A memorial to the late Dr. Charles Baskerville, professor of chemistry in the College of the City of New York, who died last January, is planned by the faculty and students of the college. It is proposed that the memorial will take one or more of the following forms: (1) The placing of a bronze tablet on the Chemistry Building, which is to be renamed Baskerville Hall. (2) The founding of a fund to provide for a medal to be called the Charles Baskerville Prize and to be awarded each year to the student doing the best work in chemistry. (3) The establishment of a scholarship to permit students who qualify to pursue courses in advanced chemistry. Subscriptions to the fund should be sent to Professor W. L. Praeger of the college.

---

* [illegible] 1921

[1] Address before Metropolitan Section A. S. M. E., April 14, 1922.

Progress in Human Engineering

A Discussion of Principles of Trite Application to Present Problems of Industrial Chemists

By Dr. Walter Dill Scott
President of Northwestern University

STUDENTS in institutions of higher learning have always been attracted by the learned professions. These primarily are the phases of human endeavor in which service to society is the recognized aim. This applies equally to theology, law, medicine, teaching, and the traditional types of engineering. Historically the learned professions may have been conservative but the last seventy years have been for them an epoch of progress. The professions are still attractive, but they are meeting severe competition in other fields in which distinct service is being rendered to society and in which great progress is being made.*

DR. WALTER DILL SCOTT
President of Northwestern University

Thus, special progress was made in agriculture in America in the years from 1850 to 1900. In these five decades the quantity of our agricultural products was increased almost fivefold, and America thus became the great food producing nation of the earth.

About 1880 the term "scientific management" began to be used in industry. The introduction of adequate systems of cost accounting made it possible to discover and to eliminate expensive and unnecessary operations. The invention of labor-saving devices enabled the manufacturer to produce a given product with fewer workers. The standardization of products resulted in quantity production with its attendant reduction of cost. The application of physics and chemistry revolutionized many of the important processes of manufacture. As a result of all this more progress was made in industry in the four decades from 1880 to 1920 than in any preceding period.

The advance in agriculture and in industry made necessary a corresponding progress in commerce. There is but little advantage in greatly increasing the supplies of goods or of manufactured goods unless there is a corresponding increase in the available market to absorb them. This condition resulted in the world-wide struggle for expanding markets and in the creation of such new agencies and methods of commerce such as department stores, chain stores, mail-order houses, trusts, systems of credits, and improved facilities of shipment on land and sea.

The facts warrant the statement that since 1850 the world has experienced the greatest epoch in progress in each of the learned professions and in each of three other fundamental phases of human endeavor—in agriculture, in industry and in commerce.

Our college students are questioning whether further progress in these fields is to be expected or whether the greatest progress is to be atained in some other field of human endeavor.

There has been widely expressed hope that the World War with all its destruction would usher in a new epoch in some phase of human progress, and that this progress would be quite the equal of any to which reference has been made. There are many who believe that we are now in the early stages of such a period of progress and that the field in which this progress is taking place is what may for our purpose be spoken of as HUMAN ENGINEERING. The term "Human Engineering" applies to all efforts made to enable the individual to promote his own welfare and the welfare of society as a whole.

Progress in the learned professions, in agriculture, industry and commerce has like the ballot, been in the hands of the male members of society. Progress in Human Engineering is not only contemporaneous with the 19th amendment but it seems to be the field of human endeavor in which the woman is destined to be quite the equal of the man.

In the early stages of a profound change it may be difficult to discover whether the change is one of progress or regression. Many would have denied that the changes in 1855 denoted unprecedented progress in the learned professions and in agriculture, or that the changes in 1885 denoted unprecedented progress in industry and in commerce. It may be impossible to demonstrate that an epoch of progress in human engineering began in 1914, but evidence is accumulating that such is the case. Indeed some assert that this progress is now so far advanced that it is possible to discover the significant agencies employed in producing the progress and to take steps to increase their effectiveness.

Vocational Guidance, Education and Motivation

These agencies have taken on new meaning and assumed an importance not previously anticipated. These three agencies all apply to human engineering in the home and the school, in industry and commerce, in the city and the country, in military and civil activities. Wherever progress is being made in human engineering it manifests itself directly in the changes taking place in vocational guidance, education, and motivation.

These changes might be illustrated from any field of human endeavor and might be appropriately illustrated from our school systems. However, they can be more definitely and helpfully illustrated from industry because the changes there are so apparent and they affect the lives of so many millions of men and women.

---

*Convocation address of Dr. Scott at the 124th Convocation of the University of Chicago, March 21, 1922. Dr. Scott's discussion of the principles and progress of Human Engineering is presented in Chemical Age because of its opportune application to the project of the American Institute of Chemistry.

Vocational Guidance

In the past the ideal of vocational guidance of or vocational selection in industry has been *to secure for each job the best worker at the least cost.* This has not necessarily resulted in a disregard of the worker. Even in slavery the master commonly regarded the interest of the worker. Vocational guidance and vocational selection have usually been carried out beneficently by the employer but they have been carried out primarily in his interest.

In the new conception of vocational guidance and vocational selection the emphasis is radically changed. This newer point of view is that *every worker should be placed in that position where he has the best possible chance to make the most of himself.* This must be interpreted as consistent with the interests of the employer and as consistent with the larger interest of society. Emphasis on the interest of the worker is so new and so novel that no firm is able to carry it out completely at the present time. This ideal, however, is characteristic of the present period of progress and will be more nearly attained with each succeeding year.

Relatively little advance in the practice of vocational guidance was made until the beginning of the World War, when we began to employ scientific procedure in our judgment of the fitness of applicants for particular positions. This judgment includes measurements of the industry and the stability, the initiative and the ambitions, as well as the physical strength, the mental alertness, and the trade skill.

The purpose of judging men in industry is to determine their fitness for particular positions. The value of such judgments is slight unless there is a fairly good understanding of the requirements of the available positions. Ten years ago there was not an industrial organization in America that had serviceable occupational descriptions of its various jobs. Today most of our larger industrial organizations are preparing some form of occupational descriptions. These descriptions present the best available word-picture of each job and specify the type of individual most likely to succeed and the types most likely to fail.

Significant progress has already been made in developing these necessary tools for vocational guidance, i. e., reliable methods of judging applicants and dependable and complete occupational descriptions of all the jobs in the plant. That there may be effective use of these tools of vocational guidance there must be in each plant an executive in charge of personnel. Such directors of personnel are already being appointed and they are doing much to make it possible for every worker to be placed in that position where he has the *best possible chance to make the most of himself.*

Education

The second agency mentioned in progress in Human Engineering is that of education. In the past our conception of education were such that it seemed foreign to the field of industry. It was conceived by some as limited pretty much to "readin', writin', and 'rithmetic." Others conceived it to be limited to the acquisition of knowledge, to the committing to memory such facts as the deeds of our ancestors, the statement of the laws of nature or even the laws of grammar. The point of view of the school man was that we should have culture for culture's sake, art for art's sake and pure learning uncontaminated by any practical application. The business man looked upon education as something theoretical and impractical; as a process that must be completed and from which the youth must be graduated before entering into his life's work. The school man and the business man agreed in assuming that education was confined to the school room and that any attempt to mix education and business would result in corrupting the school and weakening industry. Over the door of the employment office of a large and progressive factory hung until recently the significant statement, "College Men Not Wanted."

No significant progress could be made until the various social sciences had stated the aim and provided a helpful definition of education in industry, and until educational psychology, the newest of the social sciences, had indicated how such an end might be attained. In keeping with the teaching of the social sciences education in industry has been defined simply but satisfactorily as "Profiting by Experience." This new conception wipes away all the sharp contrasts between formal and informal education or between the school and industry as centers of education. It leads inevitably to the conclusion that *the education of each individual should be continuous throughout his entire period of employment.*

In considering the education of his men the employer must think of each employee as a worker, as a possible potential junior officer of the company, as a member of a family, as a member of the community, as a member of a church, as a citizen of the state and as a human being. The education in industry must provide for the continuous development of each of these phases of the life of the employee.

As a worker the employee may have had previous experience, but it is the task of his superiors to see that he continues to increase his technical skill. If he shows any signs of leadership, a carefully planned series of transfers, promotions, and courses of formal instructions may equip him to become a valuable minor executive of the company. By the hygienic practices enforced in the shop, he may be taught the laws of hygiene essential to the health of a city and so become a better member of the community.

By the helpful co-operation received from his superiors and his fellow workers he may be taught a greater appreciation of the fact of the brotherhood of men and the Fatherhood of God and so become a better member of the Church. By participation in the shop discipline, he may be taught the essentials of a democratic form of government and so become a better citizen of the State. By a study of the service the company renders the world, and by a recognition of the part he plays in that service, he may be taught the dignity of work and the dignity of the worker and so be elevated in his own estimation and inspired with an ambition to become the highest type of human being.

Education in industry is progressing slowly but in some firms it is directed by an expert who attempts to utilize all the equipment and all the personnel of the plant in assisting every employee to profit by his experience during the entire period of his service.

Motivation

The third agency mentioned in progress in human engineering is that of motivation. The types of motive power used in vehicles of transportation have been greatly augmented during recent years. Although steam, electricity and gasoline may have always existed they were not commonly and effectively used as motive power. Likewise, the types of motivation in industrial workers have been increased during recent years.

For many centuries fear was the most common incentive to action where large groups of workers were engaged in industrial enterprises. The worker labored on because he feared the lash of the master and the oath of the gang boss, or because he feared the loss of employment with its hunger and want. The better education and the organization of the laborers have weakened the effect of fear as an incentive to action. During recent decades the employer has depended less and less on the threat of bodily pain and has substituted more and more the pay envelope as a stimulus to action. The rapid increase in wages and the rumors of even more fabulous rewards during and following the war have caused the worker to be less dependent upon his pay envelope. To supplement the earning power of fear and pay as motives to action, many helpful suggestions are being found in the teachings of the social sciences.

Psychology has emphasized the fact that individual differences are relatively small in our physical qualities and in all qualities which we share with the higher animals; but that individual differences are enormous in acquired traits, in the higher human qualities, and particularly in the response to different motives to action. This teaching of modern psychology on individual differences has established the fact that some individuals are inspired primarily by fear, others by hope; some by immediate gain, others by remote ends; some by bodily comfort, others by intellectual interest.

The emphasis on individual differences has had no more direct application than has the emphasis on the complexity of each individual in his response to incentives to action. A modern engine will respond to but a single motive power whether that be steam, gasoline or electricity. Every human being responds to an indefinite number of types of motivation. It is probable that no human being is enabled to make a maximum exertion unless he is moved by the simultaneous application of several motives. No child is obedient unless parental commands are supplemented by respect. No student makes rapid progress unless the classroom credits are supplemented by interest in the topics of instruction. No industrial worker is efficient unless the pay envelope is supplemented by interest in the work. Guided by the teachings of modern psychology many industrial leaders are experimenting wisely in an attempt to discover the incentives to action that will inspire each individual and enable him to use his hand and brain effectively.

Potentialities of Human Engineering

Those in the closest touch with the progress being made in vocational guidance, education and motivation in industry are confident that the earning power of the industrial workers in America will be doubled during the present century by the progress in human engineering. The annual productivity of these ten million industrial workers may be roughly estimated at ten billion dollars. To double this means a gain of ten billion dollars annually. This amount transcends our power of imagination.

Human engineering applies to all efforts made to enable the individual to promote his own welfare and the welfare of society as a whole. This discussion has been limited largely to a single field of human endeavor—that of industry. In conclusion an illustration will be cited from another field of human endeavor—that of the army.

Human Engineering in the Army

When the raw recruits reached the concentration camps in the fall of 1917 they were assigned to their respective units before any attempt had been made to determine their fitness. The officer in charge of a unit was provided with an official document, containing the names of the different positions constituting the unit and the number of individuals to be assigned to each position named, but he was not provided with a statement concerning the personal qualifications essential for the performance of the duties of any position. Furthermore, there was not a man in the whole camp whose task it was to help match the requirements of the position and the qualifications of the recruit. This neglect of information concerning the individual and the absence of information concerning the positions, together with the lack of an organization to place the men, resulted in such a crude form of vocational guidance that the chaos in all our camps was almost as bad as the chaos in the British camps in 1914.

Fifteen months after we had entered the war vocational guidance in the army had become revolutionized. Every recruit was studied as soon as he arrived at camp. Upon his qualification card was recorded all available information concerning his fitness for any form of military service. In this record were included such items as schooling, previous occupation, trade skill, general intelligence, leadership ability and preferred type of service. There was available for every position in the organization an occupational description containing a statement of the qualifications desirable or necessary for the successful performance of the duties of that position. In each divisional concentration camp there was a personnel officer with possibly a hundred subordinates. The task of this officer and his subordinates was to direct the work of vocational guidance in the camp. The result of this progress in vocational guidance was that talent was conserved, effective units were organized quickly and the period of training was reduced.

Progress in education in the World War cannot be described so concretely as can that in vocational guidance, but features in that progress are indicated by such changes from the ordinary regular army procedure as the change from the "memoriter" to the "project" method of instruction; the change in the seat of army education from the army posts to the special schools and to the universities. The change in the conception of the province of education resulted in a universal system embracing even the generals, as in the school exclusively for generals at Langres, France.

The Spirit and the Exploit of Alvin York

Progress in motivation in the army may be illustrated from Colonel Gordon Johnson's account of the progress the army made in supplying incentives to action to a single soldier. Alvin York, a youthful mountaineer, was drafted and sent to Camp Gordon. A few days after entering camp he was ordered out to the bayonet drill. He stated to the captain his conscientious scruples against such a drill. According to the traditions of the army there was only one way to treat a conscientious objector and that was to "treat 'em rough." The captain hesitated to apply the only incentive he knew because York's calm manner indicated a determination that could not be moved by fear. Accordingly, the captain sent York to the major of the battalion. In response to the major's inquiry York replied that he believed in the Bible; and that the Bible stated: "Thou shalt not kill." The major attempted to counter with an appropriate verse but his memory failed him. Thereupon he beat a strategic retreat by ordering the private back to his tent.. He was convinced that threats, punishment and cruelty would have no effect on York, but that he might possibly yield to some really high motive to action. The major was a religious man, believed our aim in the World War was to "advance the Kingdom of God on earth," and that the Scriptures would justify war in such a holy cause.

York was ordered to the major's quarters the next evening, but again the major's knowledge of the Scriptures was unable to cope with the situation. These nightly conferences between the busy major and the ignorant conscientious objector lasted for five weeks till at last the private was convinced that there was Scriptural authority for carrying on what he came to see as an attempt to advance the "Kingdom of God on earth." Spurred by this high motive, York entered into every phase of military training with an ardor unsurpassed by any private in Camp Gordon. His major had provided him with the incentive to action that enabled him to use his hand and brain effectively.

Every American schoolboy has heard how York captured single handed 132 German prisoners in the Argonne Forest. A part of the history not so well known is this: Colonel Johnson called York to headquarters to ascertain the facts at first hand. He asked York how many Germans he had killed but could get no estimate as to the number. York stated, however, that he had completely emptied his two automatics and had used all the shells from his belt except those in the extreme back. This indicated that York had taken about sixty shots at the Germans. Colonel Johnson said to him, "How many shots did you miss?" His reply was, "Oh, Colonel, I didn't miss none of 'em!"

If in Camp Gordon the army had attempted to use fear as a motive to action, York would have refused to submit and would in all probability have been sent to the Federal prison as an incorrigible. By bringing to bear a higher motive to action the army enabled York to accomplish his remarkable service. It is impossible to state how much the service of a single soldier was increased by wise motivation, but we can state that it changed a rebellious conscientious objector into one of the greatest heroes of the American army.

Some of us are confident that the greatest progress in human engineering will be made not in the fields where the progress can be measured by billions of dollars, nor by the number of Germans captured and slaughtered but in such fields as the arts and the sciences, the home, the school and the church where progress is measured in the humanitarian terms of appreciation, sacrifice and service.

A consideration of the progress of human engineering in industry and in the army should encourage us to seek a corresponding progress in our individual careers and in our respective fields of service. I would urge each of you to contribute to the progress in human engineering by choosing for yourself a worthy career, by training yourself thoroughly for that career, and by following the highest motive in that career. In pursuing this high purpose some of you will enter the learned professions, others will enter agriculture, industry and commerce, and some of you will confine your activities to home-making.

I would urge each of you to further the progress in Human Engineering also by *co-operating to place every individual of this generation where he has the best possible chance to make the most of himself*, by co-operating to provide every individual the best possible education in school and out of school, and by co-operating to provide a form of motivation that will aid every individual to use hand and brain as effectively in all fields of human endeavor as did York his hand and brain in the field of service to our common cause.

Solid Absorbents in the Natural Gas Industry

By George A. Burrell

Consulting Petroleum Engineer

We are entering a new era in the extraction of gasoline from natural gas. First we had the compression process. In 1913 the oil-absorption process entered the field. In 1921 the natural-gas gasoline production probably amounted to 450,000,000 gallons of which the compression process produced about 70 per cent. and the absorption process about 30 per cent. This was over 10 per cent. of the total gasoline produced. Economically speaking, the natural-gas gasoline produced meant much more than this quantity. It meant as much more naphtha mixed with it, thereby making the heavier cuts fit for motor use. Natural-gas gasoline at one extreme and cracked gasoline at the other end of the distillation curve made possible the operation of 3-4 million more motor cars than would have been otherwise possible. There were 10,450,000 cars registered last year.

Many improvements have been made in the two natural-gas gasoline processes. They have been combined frequently, and some installations, not strikingly successful, have employed temperatures made artificially low. But now comes the use of solid absorbents, a radical departure in gasoline-plant operation. Activated charcoal, Silica gel and Iron gel all have been proposed. It matters not that the writer was instrumental in introducing activated charcoal to the industry.

Solid absorbents are here to stay, and the more quickly the industry appreciates it, the sooner will they increase their gasoline yields and make a better grade of gasoline. The writer feels that activated charcoal is the best absorbent, but Patrick also feels that way about Silico gel and Wilson thinks well of Iron gel. There is a place for all absorbents that are good. A process has to survive on its own merits and all new processes, no matter how good, have a rocky road to travel. Only those who work an idea through the laboratory, small scale, financial and patent stages can appreciate this. But it happens that many have had this experience.

The principle of solid absorbents is well known. Suffice it to say here that the yield is greater, the product better and the installation and operating costs lower. It is certain that the time is not far distant when no oil processes will be installed; the casinghead gas plants, instead of being combination compression and oil absorption processes, will be combination compression and charcoal processes. The charcoal cooling problem on casinghead gases of over 3 gallon-contents, where the residual gas is of small quantity, has not been solved entirely but it will be solved soon. Compressors are needed of course to force gas back to leases, and to market, but charcoal will work well at 5 lbs. pressure. Solid absorbents also will be used extensively in refinery practice to strip tail gas of its gasoline, and will force the oil process out of artificial gas plants to recover benzol and toluol (light oil). They also will be used in many industries for recovering solvents

Synthetic Acetic Acid

A NUMBER of methods of producing acetic acid synthetically have been discussed in recent years. These methods naturally involve procedures of combination of oxygen with acetaldehyde, and various processes have been proposed for effecting this combination.

Acetic aldehyde is described in standard works as a body which is readily oxidizable and capable of directly absorbing oxygen from the atmosphere for transformation into acetic acid.

Great difficulties are, however, encountered as soon as one desires to prepare a large quantity by this method. If, for example, a current of air or oxygen be caused to pass into aldehyde maintained at approximately 0° C. and contained in a vessel provided at its top with a reflux cooler, a sufficiently rapid absorption of oxygen will take place, but no acetic acid will be formed. A colorless liquid will be obtained having a peculiar odor difficult to define and this liquid, on reaching the temperature of the room, will decompose sharply with such development of heat that it would be dangerous thus to prepare even a few centigrams. The product of this violent decomposition is pure concentrated acetic acid.

Thus the initial product resulting from the absorption of oxygen by aldehyde is not acetic acid as generally admitted but a compound, only slightly known and not very stable, the properties of which in the aggregate seem to point to the probability of its being peracetic acid formed by virtue of the equation

$$\underset{\text{Acetaldehyde}}{CH_3CHO} + \underset{\text{Oxygen}}{O_2} = \underset{\text{Peracetic Acid}}{CH_3CO_2HO}$$

If subjected to heat it would decompose in accordance with the equation

$$\underset{\text{Peracetic Acid}}{CH_3CO_2HO} = \underset{\text{Acetic Acid}}{CH_3COOH} + \underset{\text{Oxygen}}{O}$$

whereas in the presence of aldehyde the decomposition would take place in accordance with the equation

$$\underset{\text{Peracetic Acid}}{CH_3CO_2HO} + \underset{\text{Acetaldehyde}}{CH_3CHO} = \underset{\text{Acetic Acid}}{2\ CH_3COOH}$$

In both cases the product resulting from this decomposition would be pure acetic acid.

Whatever may be said of these explanations, past experience proves the dangers presented by all processes of oxidation of aldehyde by atmospheric air or by oxygen when no special precautions are taken to prevent accumulation of these products having so little stability.

To avoid this dangerous accumulation, among other arrangements it has already been proposed to effect the oxidation in the presence of cerain catalyzers which bring about the decomposition of the peracetic acid as and when it is formed. Among these catalyzers, manganese salts have been proved to be particularly active.

It has also been proposed to carry out the oxidation of acetaldehyde vapor by means of air or oxygen at temperatures of say 80° to 100° C. in oxidation towers, either in the presence or absence of a catalyzer, and in these circumstances, in normal working, peracetic acid, if formed, will be decomposed in the oxidation towers. When working without a catalyzer it may sometimes happen, however, that owing to accidental cooling of the towers, etc., this decomposition of peracetic acid does not occur and the resulting accumulation of this peracetic acid would involve danger of an explosion.

As laboratory experiments these proposed synthetic processes are quite simple but from a commercial point of view Howard W. Matheson, vice-president, Canadian Electro Products Co., Ltd., characterizes them for the most part as impracticable, for various reasons, such as the high cost of catalysts used, high cost of preparing pure oxygen, the small production of acid, or the difficulties of purifying the acid, and the danger of serious explosion due to the use of pure oxygen.

From a commercial point of view, the acid must be produced fairly pure and readily purifiable; the time of reaction must be reasonably short; the catalyst used must be inexpensive; and the whole process must be capable of being carried out on a large scale in commercially practicable apparatus. It is obvious that many operations may be carried on under laboratory conditions and with laboratory apparatus, which are utterly impracticable or impossible on a commercial scale, owing to the cost of materials and the very great difference in the possibilities of small laboratory apparatus and large commercial equipment.

Mr. Matheson has devised improvements in the manufacture of acetic acid from acetaldehyde whereby the acid may be produced in commercial quantities in a high state of concentration and purity, by the use of inexpensive materials and comparatively inexpensive and commercially practicable apparatus. It has been found that the rate of combination of oxygen and aldehyde can be very greatly increased if the reaction is carried out under considerable pressure, and furthermore, that the reaction proceeds more rapidly and effectively at high temperatures. This is a fortunate circumstance, as the possibility of using high pressures makes it possible to use higher temperatures than otherwise would be feasible, as the increase of pressure naturally raises the boiling point and permits the reaction to be carried out at higher temperature without ebullition and without vaporizing the aldehyde. Under these conditions oxygen may be absorbed completely from air, leaving only nitrogen mixed with aldehyde and acetic acid vapor.

In the development of this synthesis it has been believed that the production of acetic acid proceeds much more readily in the presence of an excess of acid, and in some instances, an initial charge of acetic acid was provided in the reaction vessel. Mr. Matheson finds that the presence of acetic acid is not essential to a satisfactory reaction, as the production of acid by his process takes place as rapidly in pure acetaldehyde as in a mixture of aldehyde and acetic acid. This process consists briefly in passing air through acetaldehyde under pressure up to 120 lbs. per square inch in the presence of a suitable catalyst, and maintaining the temperature at the degree of greatest efficiency for the pressure used, viz., between 20 and 75° C. The vapors which form in the kettle are condensed under the same pressure as obtains in the kettle; the products of condensation which are weak acid and aldehyde are returned to the reaction vessel. Gases escaping from the condensers are scrubbed to remove aldehyde. When the reaction is complete the acetic acid is purified by distillation.

Procedure

The reaction vessel, aluminum-lined to resist the attack of both aldehyde and acetic acid, is provided with a closed coil for the use of water or steam, whereby the temperature of the reaction may be regulated. Air is introduced through a pipe terminating in a perforated spiral at the bottom, whereby it is distributed through the mass of the aldehyde. Agitation thus provides not only intimacy of contact, facilitating absorption of oxygen, but serves to keep the catalyst in suspension until it is dissolved. The vessel is charged with 1,000 gallons of aldehyde and about 0.5 per cent. of catalyst. While a number of substances are available as catalysts, manganese acetate is found most suitable from the standpoint of its action and low cost. Steam or warm water is now passed through the coils to raise the temperature of the aldehyde rapidly to a point where it will react with the oxygen of the air, viz., 20-25° C. Air is now passed in through the air pipe at a rate up to about 300 cubic feet per minute, and the air bubbles up through the entire mass of the aldehyde. The aldehyde absorbs oxygen from the air and is thus converted into acetic acid. This action is accompanied by great liberation of heat, which is absorbed by water passed at a suitable rate through the coils to keep the temperature to the desired degree. When the reaction commences, the pressure is allowed to rise slowly to about 75 pounds per square inch, and the temperature is also allowed to rise slowly to about 65° C.

Under these conditions, the oxygen of the air is entirely absorbed, and the aldehyde converted into acetic acid, thus leaving nitrogen, and possibly a small amount of carbon dioxide, in the reaction vessel. The nitrogen is allowed to escape. As the escaping nitrogen entrains a considerable amount of acetic vapor and aldehyde, it is passed through a condensing apparatus maintained at the same pressure as the reaction vessel, where the acetic acid and aldehyde are condensed, and from which they are returned to the reaction vessel.

This condensing apparatus takes the form of a water condenser maintained at a temperature of 1-5° C., into which the vapors first flow, and a brine condenser kept at a temperature of —10° to —15° C., into which the vapors escaping from the water condenser pass. The greater part of the acetic acid vapors are condensed in the water condenser and the greater part of the aldehyde in the brine condenser. The condensation product obtained from each condenser is returned to the reaction vessel through U seals.

Vapors not condensed escape through a relief valve set according to the pressure under which the reaction is carried out to a scrubber, which is kept at a pressure of say 20 pounds to the square inch. The scrubber is supplied with ice-cold water and serves to remove uncondensed aldehyde from the nitrogen, which is allowed to escape to the atmosphere. The operation of the scrubber is not essential to the carrying out of the process, except from an economic point of view. It has been found that from 6 per cent. to 8 per cent. of the original amount of aldehyde may be recovered in the scrubber, which when suitably rectified can be used again.

At the end of from 8-18 hours, the reaction is complete, and the kettle contains crude acetic acid of 95 per cent. concentration, or over, together with the dissolved catalyst. The contents of the kettle are discharged into storage tanks and refined in stills; the distilled product being acetic acid of a very high grade of purity, averaging from 98-99.5 per cent. concentration. In appearance, it is a clear liquid of very pale straw color, or practically colorless, when drawn off from the reaction vessel. This process not only produces acid of great purity, but also gives a very high yield, averaging from 88 to 95 per cent. of the theoretical amount.

One of the great advantages of Mr. Matheson's invention[*] is that by utilizing both high temperature and high pressure, oxygen can be completely absorbed from the air, so that the gases passing from the reaction vessel contain no free oxygen, along with the nitrogen and aldehyde vapors. This is an essential feature, as it has been found that the presence of even a small percentage of oxygen with the aldehyde makes the mixture extremely sensitive to explosion. Another advantage is obviously the ability to use air instead of previously prepared oxygen. Still another advantage is the very large yield of practically pure, highly concentrated acid produced in short periods of time.

Use of Invertase in Cane Sirup Manufacture

The tendency of sugar-cane sirup to crystallize or ferment, depending on whether it is made thick or thin, has caused a great deal of trouble to sirup makers, If made thin it will ferment unless sterilized, but sterilization is impracticable unless the sirup is put up in cans. If made thick enough to materially lessen the danger of fermentation, there is trouble from sugaring. Recently, however, the Bureau of Chemistry of the U. S. Dept. of Agriculture has developed a new process which promises to do away with these difficulties. This new process calls for the use of invertase, which is an enzyme made from yeast. Already a number of manufacturers are trying out the invertase method on a large scale.

Sugar-cane sirup contains two kinds of sugar, sucrose and invert sugar, the former in much the larger amount, but the degree of sweetness does not depend at all upon the proportions of these two kinds of sugar. Sucrose, however, crystallizes much more readily than the invert sugar. By adding a small amount of invertase to the sirup in the process of manufacture, it is possible to change some, or even all, of the sucrose into invert sugar, which permits, then, a higher concentration without danger of crystallization, The thicker sirup which is made possible because of this inversion will not readily ferment. The process is similar to that employed by bees in changing the sucrose in nectar into invert sugar, and permits the bees to concentrate the honey so that it takes up less room and will not ferment nor sugar so readily. The bees have an enzyme of their own.

The inversion of the sucrose in cane sirup can be brought about by the use of acids, but this affects the flavor and color. Invertase is absolutely inert, except for the effects it has of changing one kind of sugar to another kind. It leaves no taste or color, and has no effect whatever on persons eating sirup to which it is added. One pound of it is sufficient to cause the necessary inversion in about 800 gallons of sirup, and it is so highly standardized that its activity is practically constant.

With this new process it is now possible to produce a very thick sirup which will not readily ferment in warm weather and one which will not ordinarily crystallize. The invertase process may also be of value to those manufacturers and packers of simple sirups, maple sirup, mixed or blended sirups, and sirups made especially for the soda-fountain trade, especially wherever it is desired for any reason to market a heavier bodied sugar sirup than would otherwise be possible. Thick sirups keep better and do not cost so much to ship.

Binney & Smith Co., for over 20 years located at 81-83 Fulton St., New York, is the latest manufacturer of chemicals to join the immigration to the new commercial center about the Grand Central Terminal, where it will be located at 41 East 42d St., on the nineteenth floor of the Liggett Bldg., 42d St. and Madison Ave. During its occupancy of the former premises its business has expanded greatly to embrace every type and grade of black pigment used, in addition to the manufacture of oxides, clays, talcs, crayons, chalks and water color paints.

---

[*] U. S. Letters Patent No. [illegible], issued March [illegible] 1922

Biscuit and Cake Manufacture

Influence on Finished Products of Several Ingredients with Especial Reference to the Action of Milk

By Washington Platt, Ph.B., M.A.

Production Manager, Harris Laboratories, Tuckahoe, N. Y.

WHILE considerable scientific and technical experimentation has been done on bread-making, little attention has been paid to other baked products, and little or nothing from a systematic point of view has been published on this subject. The present and concluding articles, therefore, represent a systematic investigation into the manufacture of the principal baked products other than bread, i. e., biscuits and cakes of various kinds, in which effort has been made to trace the effect of each ingredient on the dough and the consequent effect on the finished product. This preliminary investigation contributes to an understanding of later experiments on the commercial value of milk in baked products.

WASHINGTON PLATT, PH.B., M.A.
Production Manager, Harris Laboratories, Tuckahoe, N. Y.

Like metallic alloys, the character of the finished article in baked products depends both upon the ingredients used and the mechanical treatment. An experienced man can tell by the appearance of the product approximately the kind and the proportion of the ingredients used and the method of manufacture which has been followed. The following types of baked products will be considered:

I. *Sweetened and Unsweetened Biscuits.* The term "biscuit" is used for want of a better one, and includes all baked products made of a fairly stiff dough rolled out into sheets, cut into shapes on a so-called "cutting machine" and finally baked. This class includes a considerable variety of products ranging from hardtack to sugar cookies and ginger snaps, all of which are made in the manner named.

II. *Drop Cakes.* These are made from a liquid batter deposited in small quantities on pans by a so-called "wire cut machine." Small, flat cakes such as base cake, vanilla wafers, etc., are included.

III. *Pound Cakes.* These are large, rich cakes containing a large proportion of eggs and shortening, given a long, slow bake of several hours in deep tins.

IV. *Sugar Wafers.* These consist of a top and bottom with a filling in between. The top and bottom are the baked parts and are made separately from a very thin batter.

In all discussion of baked products the unit is the barrel of flour, consisting of 196 pounds net. Batches of dough are referred to as five-barrel batches, meaning batches consisting of five barrels of flour together with all the other ingredients necessary to make up the mixture required. The weight and bulk of a five-barrel batch, therefore, varies with different biscuits on account of the variation in the other ingredients used with the flour.

Biscuits

The first step in the manufacture of a biscuit is the mixing. This is done in large, mechanical mixers holding from two to five barrels. The mixing arms revolve slowly, i. e., from 10-16 revolutions per minute. The sugar and shortening are first put in, then the following ingredients in order: eggs; flavor; wetting; chemicals such as soda, salt, ammonia, tartaric acid, etc. The mixture of these results in a thick, syrupy mass. To this the flour is added and the whole mixed for from twenty minutes to an hour.

The next process is to roll the dough out into sheets. With the stiffer dough such as hardtack this has to be done on special heavy rollers, the dough being folded several times after each passage through the rollers. This gives the biscuit a structure consisting of layers. On baking, these layers separate more or less, resulting in a biscuit which is lighter and crisper than one consisting of a solid mass. With the softer and sweeter doughs such as sugar cookies or ginger snaps, one passage through the rollers is sufficient.

The last rollers through which the dough passes in either case are rollers forming part of a cutting machine. This machine then carries the dough on a canvas belt under a cutter which divides it into shapes, generally circular or square. These pieces of dough are deposited mechanically onto sheet steel pans which are baked in a reel oven. A reel oven is about 20 ft. by 20 ft. by 20 ft., with a small coal fire in the bottom of the chamber. Large iron shelves are carried around inside the oven like the cars of a ferris wheel. These carry the pans of biscuit from the mouth of the oven around the whole circuit and finally return them to the oven-mouth properly baked. The baking takes from 15 minutes for some hardtack down to 3 or 4 minutes for small, sweet biscuit.

The gas-fired traveling oven, built directly on the floor without structural apertures, represents a progressive step in oven equipment. In this type of oven the goods pursue a horizontal instead of a circular travel and under conditions permitting not only instantaneous control of heat in different parts of the oven, but an adaptability to varying requirements impossible with the reel-oven.

The influence of the various ingredients can best be ascertained by a general survey of types of biscuit, beginning with the simplest possible, such as hardtack, and tracing the gradual changes in the finished product as more and more sweetening and sugar are added to the dough, resulting finally in types such as ginger snaps or short bread.

Hardtack and Pilot Bread. Hardtack is made merely of flour, salt and water. The biscuit is hard and coarse with an internal texture made of a comparatively few thick layers. Its principal advantage is that it is cheap and will keep for many months in any climate. If some shortening, to the extent of about 15 pounds per barrel, is added to this simple flour-and-water mixture the result is pilot bread. This is less hard and tough than hardtack. The biscuit is crisper and has a more even color, the flavor is pleasanter. The biscuit will not keep as well, however, as the fat will eventually become rancid. As the addition of more and more shortening to an unsweetened mixture of this kind is continued, the qualities of flakiness and shortness in the finished product are accentuated until a final product not unlike pie crust is reached.

Products Yielded on Addition of Shortening and Sugar

Sugar is never added to a flour-and-water mixture without an accompanying addition of shortening, as the dough in such case would be very sticky and the resulting product hard and heavy. When a small amount of sugar and shortening are used, e. g., 20 lbs. of shortening and 40 lbs. of sugar to the barrel, the so-called "hard sweets" result which comprise biscuit such as Albert crackers, extra wine biscuit, etc. The dough in this case is stiff and tough, not unlike hardtack dough; the resulting biscuit, however, is very much more crisp and tender. The internal texture is finer and the whole biscuit takes a rich, even, brownish-yellow color on baking.

The use of more shortening and sugar, to the extent of 28 lbs. of shortening and 75 lbs. of sugar to the barrel, gives a biscuit similar to ordinary sugar cookies. Further addition of sugar, up to 100 or 125 lbs. to the barrel, leaving the shortening about 28 lbs. as before, gives snaps, such as lemon snaps or ginger snaps. If, on the other hand, the shortening is increased, with only a small increase in the sugar, short bread like the Scotch short breads, results. Biscuits of this kind are close in texture. The large amount of shortening present, which may reach 70 lbs. to the barrel, is shown by a tendency to greasiness in the finished biscuit.

This general survey will make clearer the following more detailed study of the influence of each ingredient on the finished product.

Shortening

Under this head are included all edible fats and oils used in baking. The commonest are butter, lard, lard compounds, cocoanut oil, cotton seed oil, and to a smaller extent corn oil and peanut oil. The effect of shortening on the dough is to make it short and less sticky. This latter is of considerable importance, as a dough which is too sticky may stick to the rolls and cutter to such an extent that it cannot be handled commercially on the cutting machines.

All the other important ingredients used in dough, except shortening, are soluble or miscible with water. Flour contains two principal proteins, gliadin and glutenin, both insoluble in water. On mixing of the dough with water the gliadin and glutenin form a sticky mass known as gluten. As the mixing proceeds the strands of gluten coming into contact with one another stick together and are then stretched apart, and are brought into contact with other strands of gluten. In this way the gluten is said to "develop." The whole mass of dough becomes much tougher and more coherent.

When shortening is present, however, the strands of gluten become partially coated with fat so that they do not coalesce and stick together easily when brought into contact with one another. Thus, shortening tends to prevent the dough from getting tough. Likewise the presence of layers or droplets of shortening in the dough form breaks of continuity in what would otherwise be a more or less solid and continuous mass of dough. All of the other ingredients stick together because they are all soluble in water or wetted by it. A somewhat similar process probably occurs in such dough as pilot bread and hard sweets, where the dough is formed into many layers by successive rolling into sheets, folding many times and re-rolling. In this case the shortening, spreading out on the surface of the sheets, undoubtedly prevents them from coalescing to so large an extent as would occur if they came into contact without the presence of shortening on the surfaces. A small amount of shortening probably can accomplish this result in a manner very similar to that by which a small amount of lubricating oil keeps apart metallic surfaces in a bearing.

The results of this action of shortening in the dough are seen in the biscuit after baking. Biscuits containing shortening have a finer structure and are more brittle than similar biscuits made with less shortening. An example may be seen by a comparison of hardtack with pilot bread; likewise sugar cookies and ginger snaps, made according to the usual formula but without any shortening, are so hard that they cannot be broken with the teeth.

Shortening also has an effect on the appearance of a biscuit. Biscuits containing shortening are generally more glossy and richer in appearance, and color more easily and evenly on baking.

Many biscuits have a pronounced flavor due to the presence of molasses or some flavor or spice such as lemon oil, cinnamon, mace, ginger, etc. In biscuits without any pronounced flavor of this kind the flavor due to the shortening is often important. Butter gives a delicious, rich flavor all its own, which cannot be imitated or even approached by any known ingredient. This is the only reason for using butter in a biscuit, as many other fats surpass it in shortening power. Lard gives a very mild but pleasant flavor to biscuits such as pilot bread and the few hard sweets. Cocoanut oil is practically without flavor. The flavor of cotton seed oil is not pleasant, so it should not be used in large amounts with those mild-flavored biscuits in which its taste can be noticed.

The problem of shortening is at present the most important which the biscuit baker is called upon to solve. Shortening is the most expensive of the principal ingredients used in biscuit baking. It is also the one which gives the most trouble. In hot weather shortening will often collect into little pools and so partially separate from doughs which contain a considerable amount of it. In this form it is, of course, naturally without action in shortening the dough. Some of it also squeezes out as the dough goes through the rollers of the cutting machine and is thereby lost.

In the finished product shortening may partially run out of the biscuit, giving it a greasy appearance and making a grease spot on the paper if the biscuit is packed in a cardboard carton. More important still, shortening is the first ingredient in the biscuit to spoil. Under the ordinary conditions existing in a grocery store or pantry, biscuits after a while lose their crispness and become soft. In this form they are less appetizing, but they are not spoiled in any way and are entirely fit to be used for human food. If shortening is present, however, it eventually becomes rancid, giving the biscuit an intensely disagreeable odor and taste, and making it worthless for human food.

Shortenings vary greatly in their keeping qualities. Biscuits containing a small amount of shortening keep longer than those containing a larger amount of the same kind. Cotton seed oil and compounds containing it go rancid much more easily than any of the other common shortenings. After this comes lard, and then butter. Cocoanut oil is in a class entirely by itself. The highly refined cocoanut oil used by the baking trade keeps practically forever. For this reason it is largely used in biscuits intended for export.

Different oils and fats differ greatly in their shortening power; that is, the same amount of one oil in a dough will make a very much shorter biscuit than the same amount of another oil. The best type of shortening to use varies with the kind of product to be made. For biscuit, lard has the greatest shortening power, followed by lard compounds and cotton seed oil in the order named; then butter, and finally cocoanut oil which has very distinctly less shortening power than any of the other common fats and oils.

The action of shortening in doughs and biscuits never has been investigated carefully from a scientific point of view. The exact form in which the shortening exists in doughs and biscuits is not known. It is possible that some kinds of shortening exist more as an emulsion and others exist more in the form of thin layers; or the size of the emulsion droplets or the thickness of the layers may vary from one shortening to another. This easily could be determined microscopically by proper staining and sectioning methods. It is almost certain that such an investigation would yield results of great commercial value.

Sugar

Cane or beet sugar, that is, sucrose, will be discussed first. Sucrose when added to a dough affects the colloidal properties of the gluten so that it is softer and stickier. The dough is therefore shorter and much less wetting can be used in making it. For example, hard sweets containing 30 lbs. of sugar take 6 gallons of water to the barrel, which results in a tough, stiff dough. Sugar cookies, however, containing 75 lbs. of sugar to the barrel take only 4 gallons of water and the dough so made is a soft, sticky paste. While sucrose makes the dough short, it makes the biscuit hard and tough unless sufficient shortening is used in conjunction with it to counteract these effects. It also makes the piece of dough flatten out on baking so that a disc of dough one inch in diameter may make a biscuit one inch and a quarter in diameter.

Without sugar, biscuits puff up with an open grain somewhat like that of bread, and such biscuits are said to be "poor." This is contrasted by the baker with the flat, spreading appearance caused by sugar, which he calls "rich." The baker also uses the term "rich" in a different sense, meaning the appearance given by plenty of shortening. These two meanings of the term are really quite distinct and their indiscriminate use often is confusing.

Sucrose may be added in the form of refined powdered sugar, refined granulated sugar, soft "C" sugars from refineries, plantation sugars, or molasses. Granulated and plantation sugars are often not entirely dissolved, so that sugar crystals remain as such in the dough and even in the biscuit. Such crystals, not being dissolved, are entirely without action on the gluten. Molasses gives, of course, a distinctive color and taste to the biscuit in which it is used.

Invert Sugar

Curiously enough, honey, artificially made invert sugar syrup, and dextrose, have an action on the dough entirely different from that of sucrose, and in some cases just the opposite. Biscuits made from sucrose tend to be hard and flat, whereas biscuits made from invert sugar are soft, light and spongy. The particular grain given to a biscuit by invert sugar is quite characteristic, and cannot be obtained in any other way. The hygroscopic power of these sugars, especially levulose, tends to keep the biscuit soft, which is a quality desired in this kind of biscuit. These sugars, likewise, caramel very much more easily on heating than does sucrose. For this reason biscuits made with invert sugar color more quickly and deeply on baking. A small amount of invert sugar syrup is therefore often added to many biscuits to get this effect of a regular browning, even with a quick bake.

Commercial dextrose will give nearly the same effect in the dough as artificial invert sugar or honey. It is, however, less soluble in water than invert sugar. This means that syrups of dextrose cannot be made so concentrated as those of invert sugar if they are to be kept for several days. This is one of the reasons which prevents commercial dextrose being used for this purpose. Another reason is that it has not as great hygroscopic power as invert sugar which contains levulose.

From a commercial point of view artificially made invert sugar is more satisfactory than honey for the reason that it can be made up absolutely uniform from day to day,* whereas honey continually varies in sugar content and acidity. The flavor of the honey, however, is very attractive and cannot be imitated. Biscuits made with artificial invert sugar are, therefore, generally flavored with some extraneous flavor such as lemon oil or mace.

Commercial glucose or corn syrup is commonly used, on account of its cheapness, to a certain extent to replace part of the sugar. This syrup consists of a mixture of dextrins, dextrose and water; an average composition being dextrin 38 per cent., maltose 6.5 per cent., dextrose 34 per cent., ash 0.5 per cent., water 21 per cent.

Corn syrup has much less sweetness than sugar and also less tendency to give the biscuit a "rich" appearance by making it flatten and spread out. Biscuits made experimentally of flour, shortening, glucose (without any other sugar), leavens, and water, failed to spread, had a "poor" open grain and were extremely insipid in flavor.

Eggs

Eggs, owing to their cost, are used only in the richer and more expensive biscuit. The yolk of the egg gives an attractive color to the biscuit, but this color can be secured by adding soft sugars or invert sugar to the dough. The fat in the egg yolk also contributes a certain amount of shortening to the dough, but this effect could likewise be more cheaply accomplished by other forms of shortening.

The qualities given by the eggs which cannot be imparted in any other way are the taste and air-holding power. This latter is not so important in biscuit as it is in drop cakes and pound cakes. In certain kinds, however, such as "Five O'clock Tea," this gives a desirable effect, resulting in a very fine porous texture.

Leavens

This general term is used to cover the inorganic chemicals, except salt, which are added to the dough mainly for their gas forming qualities. They include ammonium bicarbonate, tartaric acid, calcium acid phosphate and sodium bicarbonate.

---

*Artificial invert sugar syrup is commonly made as follows:

12 gallons of water;
400 pounds of Confectioner's "A" Sugar;
12 ounces tartaric acid.

Place the water in a steam jacketed kettle; turn on the steam; add the sugar and acid. Stir and boil until the temperature reaches 225 degrees F. Draw off and allow to cool. The syrup will keep in this form for several weeks when found necessary.

Ammonium bicarbonate is the ideal gas-forming agent in that it is completely volatilized on baking so that no residue is left in the finished product. It also produces a larger amount of gas in the dough than can be secured in practice from any other ingredient. A certain amount of ammonium bicarbonate opens the structure of the biscuit and tends to make it somewhat friable, thus preventing too great hardness in the finished product. For this reason fairly large amounts of ammonium bicarbonate are often used in sweet biscuit which contain but little shortening, the ammonium bicarbonate partly overcoming the undesirable qualities in texture which would result from a lack of fats. The action of the two is to a certain extent comparable. Shortening breaks up the continuous structure of the dough, filling the spaces between with the shortening itself. The ammonium bicarbonate likewise breaks up the continuous structure of the dough, filling the spaces so formed with gas.

Another method of obtaining gas is by the use of sodium bicarbonate, here known as soda, together with some form of acid, such as tartaric acid or calcium acid phosphate. When calcium acid phosphate is used it is generally added to the water in the dough-mixer. When tartaric acid is used it is usually sifted dry into the mixer at the same time as the flour is being added. Neither of these is as efficient in producing gas and in opening up the texture of the biscuit as ammonium bicarbonate. When molasses is used the acid of the molasses makes the addition of any further acid unnecessary.

The soda used is always considerably in excess of the amount necessary to neutralize the acid. In fact, soda and ammonium bicarbonate are often used together without the addition of any acid at all. In addition to its gas-producing action, the excess of alkalinity caused by the soda has a distinct action on the gluten of the flour, increasing the spread of the biscuit on making and accelerating its browning in the oven. Without soda or a large amount of shortening, it is practically impossible to make a biscuit sweetened with sucrose only to brown evenly when baking. A high heat only results in burning the edges without browning the top properly. With the addition of soda, however, this trouble quickly disappears.

Flour

Flour may be said to form the backbone or framework of the biscuit. In bread-making a strong flour which will absorb a large amount of water and expand well upon baking, giving a large loaf of bread, is desirable. Such flours are made from Spring wheat or hard Winter wheat. In biscuit-baking, however, just the opposite qualities are preferred. The use of a strong flour gives a tough dough and a hard, tough finished product which has a "poor" appearance due to the expansion on baking and failure to spread. The flours used in biscuit baking are, therefore, those made from the soft Winter wheats. A very soft flour is valuable commercially to the baker, as with such a flour he can use less shortening in the dough and yet secure as tender a biscuit as though he used a stronger flour together with more shortening. Soft Winter wheat flours contain less gluten than the strong Spring wheat flours, and the gluten itself is of a different quality.

The causes for this difference in quality are not well understood. They have been variously assigned to a difference in the ratio of gliadin to glutenin in the flour, to a difference in the inorganic salt content of the flour or dough, and to many other causes. It is probable that the gliadin and glutenin, themselves, are chemical individuals and are identical whether derived from Spring or Winter wheat. Any investigation which would disclose methods of making the gluten in a flour strong or weak at will would be very valuable to the baker on account of the saving which he could make in the amount of shortening used by weakening the gluten of the flour. Lessening the proportion of gluten in the flour by diluting it with added starch does not give the required effect. Such an addition of starch makes the dough soggy. The biscuit is heavy and so close in texture as to be hard or tough.

Other Ingredients

An almost infinite variety of other ingredients may be added in the manufacture of the various kinds of biscuits.* Examples are ground spices of all kinds, essential oils, flavoring extracts, dried fruits such as raisins or currants, desiccated cocoanut, oatmeal, nuts, etc. The fruits, cocoanut, nuts, etc., are merely inclusions in the mixture and do not affect the texture or quality of the biscuit.

---

*For reference, the following formulas, with mixing and baking directions for typical kinds of biscuit discussed above, are given below:

Hard Sweets

1 bbl. Winter Patent Flour	6 gal. Milk
23 lb. Cocoanut Oleine	1 lb. Soda
35 lb. "C" Sugar	2 lbs. Salt
1 gal. Invert Sugar Syrup	1½ lbs. Ammonium Bicarbonate
30 lb. Cornstarch	
8 oz. Vanillin Solution	

Mix all ingredients except flour and soda well together Add flour, sift in soda and mix 35 minutes. Dough should be tough and stiff. Temperature after mixing 88° F. The dough is put through the rollers twelve times with frequent folding between each pass. Baked 10 minutes at 400° F.

Sugar Cookies

1 bbl. Winter Patent Flour	4 gal. Water
14 lbs. Lard	1 lb. Soda
14 lbs. Cotton Oil	1 lb. Salt
44 lbs. "C" Sugar	1 lb. Ammonium Bicarbonate
30 lbs. Invert Sugar Syrup	
12 lbs. Corn Syrup	½ lb. Calcium Acid Phosphate
6 oz. Mace	

After all the other ingredients are well mixed, add the flour and sift in the soda and acid phosphate. Mix 20 minutes, making a fairly soft, short, sticky dough. Temperature 75° F. Roll out into a sheet by one passage through rollers. Bake 6 minutes at 440° F.

Ginger Snaps

1 bbl. Winter Clear Flour	3 oz. Lemon Oil
30 lbs. Lard	15 lbs. Cake Meal
70 lbs. New Orleans Sugar	2 gal. Water
9 gal. Molasses	3 lbs. 14 oz. Soda
3 lbs. Ginger	2 lbs. Salt

Mix as in foregoing formula, except that the dough is mixed about 35 minutes after the flour is added. The dough is a soft, sticky paste. Temperature 86° F. Roll out into sheet by passing once through rollers. Bake 6½ minutes at 440° F.

The Ordnance Department, U. S. Army, and the Charleston Industrial Corp., have decided to sell without reserve at public auction on May 22-26 all the machinery, equipment and supplies located at the former munitions plant at Nitro, W. Va. Included in the sale will be about 400 bungalows and buildings, the latter of various sizes and types of construction. No further private sale by negotiation will be made after April 21. An illustrated catalogue of all items will be mailed on application to the auctioneers, Sam'l F. Freeman & Co., 1519 Chestnut St., Phila., Pa., or to W. K. Dolan, sales manager, Charleston Industrial Corp., Nitro, W. Va.

Avenues of Development in Petroleum Technology. Increased Efficiency in the Conservation, Distribution and Use of Petroleum and Its Products

By Dr. Van H. Manning
Director of Research, American Petroleum Institute

WE cannot overestimate the dependence of present civilization upon the petroleum industry. A keener appreciation of this relation might be enforced if we were to say that the material progress of the world in the past 50 years would have been impossible without the service of this industry.*

Confronted on the one hand by rapidly increasing demands for its products and on the other by an exhaustion of domestic resources promised within the present generation, the industry is under a compulsion to efficiency demanded in like degree of no other field of production. The performance of this responsibility is possible only by the aid of science and the fullest co-ordination of every agency devoted to making the most out of the resources in sight.

Investigations and research of the highest order are being conducted in governmental, educational and industrial laboratories, often at the expense, however, of much unnecessary duplication of effort and financial loss. While of necessity much research work is subjected to limitation of secrecy or to dominant control of processes, there is urgent need of a promoting and co-ordinating agency to foster general petroleum research of a fundamental character, the results of which can be used by all those engaged in the development of the industry.

DR. VAN H. MANNING
Director of Research, American Petroleum Institute.

Many of the problems presented are too large for any single individual or institution to cope with unaided; others are so great as to require the collective resources of the nation's educational, governmental and industrial research departments; still others may require the establishment of entirely new research facilities.

The following list of approximately seventy items is a compilation of many recommendations as to the character and scope of research which should be undertaken. It is presented without authorship or justification or without attempt to classify these problems as to their order of importance or according to their merit. Some problems are repeated under various groups in accordance with a different manner of attack and approach. It is hoped that this list will serve as a basis of discussion leading to the formulation of a constructive program.

These problems group themselves according to the operating subdivisions of the industry, viz., (1) production; (2) transportation and storage; (3) refining, and (4) marketing and utilization. These problems further are differentiated into two classes indicated in my enumeration by "**A**" and "**B**", in which the former or "**A**" class embraces all problems of known importance, the solution of which will be of material benefit to the industry and the nation. Problems of the "**B**" class are of indeterminate importance and arise through a lack of knowledge; study and solution of these problems may or may not develop results of practical value.

Production Problems

1. **B** An investigation of the use of charcoal, silica gel and iron gel for the recovery of gasoline from casinghead and refinery gases, including an examination of the character of the recovered product and the thermal efficiency of the process in comparison with oil recovery methods.

2. **A** A broad study based on thermodynamic principles of gasoline recovery processes, including the application of refrigeration to casinghead and refinery gases and development of more efficient methods and mechanical equipment in a manner similar to the work of Norton in recovering helium from natural gas.

3. **A** An investigation of blending volatile casinghead gasoline and naphtha with special reference to the economic limits of blending.

4. **A** Breaking up of water oil emulsions with maximum oil recovery and the prevention of ingress of water into the oil well.

5. **A** Increasing recovery from wells; reviving old wells.

6. **B** Chemical study of underground water in relation to oil production.

7. **A** Shale oil development.

Transportation and Storage Problems

1. **A** A comprehensive study of fire fighting and prevention methods with respect to all phases of the petroleum industry.

2. **A** Study of methods for cleaning and freeing tanks and bunkers of inflammable vapors prior to making repairs; the development of simple methods for testing such tanks to determine if they have been freed from vapors.

3. **A** Study of the protection of men from noxious gases and other hazards in the entire petroleum indus-

---

*From address of Dr. Manning at the general meeting of the American Chemical Society, Birmingham, Ala., April 4-7, 1922.

try; use of gas masks, breathing apparatus; designing tanks and apparatus so that men need not enter the noxious atmospheres.

4. **A** Investigation of storage and transportation losses and development of methods for minimizing this loss.

5. **A** Effective vapor pressures in tank cars, etc.

6. **A** Thermal expansion of petroleum affecting measurements.

7. **B** Cement storage tanks.

Refining Problems

1. **A** Recovery of gasoline from refinery gases. The importance of this problem has already been recognized and recovery plants (generally of the absorption type) are in use in various refineries for the removal of gasoline from still gases. An educational campaign should be instituted to advise refiners of the advantages of this procedure and, in addition, the recovery of gasoline from all refinery gases, pressure stills, agitator tanks, etc., should be considered. Relative efficiency of solvent absorbents, charcoal and silica gel and ferric hydroxide gel should be investigated.

2. **B** Recovery of other chemical products from refinery gases:

a. Propylene and ethylene for making alcohols, glycols, etc.

b. Chlorinated products, artificial resins, isoprene.

3. **B** Recovery of chemical products from acid sludges.

4. Conservation of chemicals used in the treatment of petroleum products:

a. **A** Decreased use of sulphuric acid. Many products are probably treated more heavily than is necessary to insure satisfactory utilization.

b. **B** Closer utilization of alkali. Many refiners simply make sure they have an excess in their treaters and do not attempt to hold this excess down to a satisfactory minimum.

c. **A** Wider use of sulphuric acid recovery plants. Application to needs of small refineries. Investigation of best type of equipment.

d. (**A**) More economical use of filtering clay and fuller's earth.

e. **B** Study of most favorable conditions, temperature, time, etc., for chemical treatment.

5. **A** Increased fuel economy (fire box to oil). There is notorious waste of fuels in refineries. Extended investigations of proper fuels and of furnace design will result in saving much fuel.

6. **A** Improved design and insulation of stills and fractionation towers. Heat losses can thus be cut down and efficiency will be increased.

7. **A** Utilization of heat liberated in condensing the vaporized oil. Considerable heat is now lost which can be saved by suitable preheaters or heat exchangers.

8. **B** Increased use of continuous distillation equipment. Development work with different types of oils is required to extend use of continuous distillation.

9. **B** Increased use of continuous treating equipment which when fully developed for various oils will result in greater efficiency of operation.

10. **A** Increased use of fractionating columns on stills will give larger yields of valuable gasoline fractions. There is need for thorough scientific investigation of fractionating columns.

11. **A** Prevention of entrainment by more efficient separating devices. The adoption of such equipment will permit much higher distillation rates than those now customarily employed.

12. Development and improvement of cracking processes and their increased use:

a. **A** For increased production of gasoline.

b. **A** For distillation to coke of oils having high content of asphalt.

c. **B** For production of lubricating oils as through use of $AlCl_3$ or similar agents.

13. **A** Improved methods of filtering lubricating oils. Use of other material than Florida clay or fullers earth and the revivification and more economical use of filter materials. Possibilities of activated charcoal, silica gel and iron gel should be investigated.

14. **B** Use of solvents for the removal of color from spent fullers earth.

15. **B** Fractionation of petroleum residues containing paraffin wax into distillate and undecomposed amorphous wax; and the elimination of gummy or asphaltic portions from wax distillate by a distillation or mechanical procedure.

16. **B** Study of nature and distribution of sulphur derivatives in petroleum. Improved methods of removing sulphur from crude oils and distillates especially by the use of absorbing agents and a study of methods for controlling the distribution of the sulphur among the various products.

17. **A** Through study of the mechanical and chemical efficiency of distillation methods as applied to various types of petroleum with special reference to the development of flexible refining methods which permit the maximum production of products for which there is the largest demand. Under this head is included a study of cracking, topping and straight cut distillation.

18. **A** Thorough investigation of the progressive deterioration of stills with reference to the prevention of explosions and the reduction of life and fire hazards.

19. **A** Standardization of analytical methods, including improvement of many of present methods and development of new methods.

20. **B** Study of physical and chemical constitution of different types of crude petroleum to provide necessary fundamental data now lacking.

21. **B** Study of various chemical reactions of petroleum hydrocarbons, particularly oxidation, hydrogenation and halogenation. Such study may lead to the manufacture of valuable base materials and intermediates for the production of organic chemicals and dyestuffs.

22. **B** Study of nature and behavior of crystalline and amorphous paraffin wax in petroleum; and investigation of wax chillers.

23. **B** Investigation of production of special products, such as:

(a) Harder grades of wax; (b) wool oils; (c) polymerized olefines; (d) benzol and toluol; (e) organic acids and alcohols; (f) drying or siccative oils; (g) isoprene; (h) dyestuffs.

24. **A** Study of the properties required of oils for use in absorbing benzol, toluol, etc., from artificial gas or insolvent recovery system.

25. **B** Thorough study of the relation between chemical constitution of oil and its lubricating properties with a view to so treating oils as to increase their lubricating power.

26. **B** Physico-chemical study of the structure and properties of greases.

27. **A** Study of methods for reducing the viscosity of Mexican fuel oil so as to eliminate the necessity of preheating.

28. **A** Dehydration of crude oils and oil emulsions.

including study of comparative efficiency and costs of the following methods: (a) Electrostatic; (b) Centrifuging; (c) Heating; (d) Miscellaneous Methods.

29. **B** Study of the influence of various types of electrical discharges and other electrical effects on cracking of oils.

Colloid Chemistry

1. **A** Thorough study of the properties and behavior of emulsions, including (a) mechanism of the formation and stability of various emulsions; (b) a study of the nature of emulsifying agents; (c) methods of breaking; (d) comparison of properties of emulsions obtained from different base oils; (e) study of various emulsion products, such as cutting oils and greases.

2. **A** Thorough study of lubrication from a colloid chemical standpoint.

3. **B** Investigation of the properties and behavior of crystalline and amorphous wax.

4. **A** Study of the application of the adsorptive action of various substances, such as bauxite, fullers earth, silica gel, iron gel, etc., with reference to the following problems: (a) recovery of gasoline from refinery gases; (b) desulphurization of both light and heavy fractions; (c) removal of coloring matter.

5. **A** Thorough study of the properties and utilization of various grades of asphalt.

Marketing and Utilization Problems

1. **A** Preparation of rational specifications for petroleum products; these specifications to be based upon the results of actual research work. More rational volatility specifications for gasoline and tests for the "oiliness" property of lubricants are especially desirable.

2. **A** Standardization of analytical methods and apparatus for petroleum products testing and analysis.

3. **A** Utilization of wider range of motor fuels in mobile types of engines (autos, trucks, tractors, etc.)

4. **A** More efficient utilization of heavy oils in Diesel and other engines of the heavy oil type.

5. **A** Investigation as to the actual need of highly refining gasoline for motor fuel; is it necessary to remove bad smelling sulphur compounds completely in order to obtain efficient service from the gasoline? Will these compounds injure the engine? If high degree of refinement proves unnecessary educate the public to use less highly refined products and thus increase the yield and lower the cost.

6. **B** Development of higher efficiency in internal combustion motors through use of selected fuels (naphthene or aromatic mixtures) or through use of chemically treated fuels which will stand higher compressions. Applies especially to aeroplane engines.

7. **A** Modify the design of carbureters and internal combustion engines so as to enable the use of less volatile gasoilne and investigate the relations between volatility, specific gravity, and distillation analysis to performance in automobile engines; relative performance of blended mixtures and straight cuts.

8. **A** Study of the fundamental causes of carbon formation in cylinders; elimination of polymerized products in cylinders; study effect of additions of peroxides, naphthalene, picric acid, phenanthrene, pyrene, picene, cyclo-hexanol, phenol, etc.

9. **B** Combustion characteristics of different hydrocarbon series.

10. **B** Ignition temperature, detonation, etc.

11. **B** Effect of volatility on fuel consumption.

12. **B** Unbiased scientific study of the difference in properties and behavior of oils from different base crudes and the fundamental causes thereof.

13. **A** Study of the relative tendency of different lubricants to absorb fuel and become excessively diluted.

14. **A** Scientific study of numerous problems in lubrication.

15. **B** Recovery and purification of used lubricating oils in large industrial plants. This would be in the interest of conservation.

16. **B** Prevention of oxidation of mineral oils in transformers.

17. **A** Development of satisfactory small scale oil-gas apparatus for use in country homes and small villages.

18. **A** Development of household oil-heating devices. Why not use oil in the furnace? It should be as convenient as gas with proper equipment.

19. **B** More effective utilization of the butanes and pentanes in natural gasoline and in light petroleum fractions. Much of this is now lost by evaporation.

20. **A** Utilization of larger proportion of petroleum coke produced. Due to impurities much of this coke is not suitable for carbon products. Elimination of impurities and improvement of quality should be investigated.

21. **B** Production of oil-gas and also hydrogen by cracking natural gas, or petroleum vapors with the production of a carbon black that will meet the same requirements as carbon black made by the incomplete combustion of natural gas.

22. **B** Broad physico-chemical study of the production of carbon black, with a view to the discovery of more efficient methods than the wasteful partial combustion process.

The Canadian Institute of Chemistry will hold its annual meeting with that of the Society of Chemical Industry on May 15-17 at Ottawa, Canada.

* * *

Dr. Herbert R. Moody, assistant professor of Applied Chemistry and Applied Analysis, College of the City of New York, has been elected to fill the position of professor of Chemistry and Director of Laboratory, made vacant by the death of Dr. Charles Barkerville. Dr. Frederick E. Breithut has resigned as assistant to the president of the Calco Chemical Co. to succeed Dr. Moody. Dr. Breithut left educational work at the City College to serve during the war as Major, Chief of Personnel, Chemical Warfare Service. His subsequent experience in administrative industrial work in chemistry will give him, in his return to his early environment, exceptional fitness in the interpretation of the place of chemistry in economics.

* * *

The kelp-potash plant of the Bureau of Soils, U. S. Department of Agriculture, at Summerland, Cal., was sold on April 1st to Rodney Benson of Santa Barbara. This plant was constructed in 1917 and operated for four years as an experimental and demonstrational plant with a view to the development of processes for extracting potash and by-products from the giant kelps of the Pacific. It was closed through Congressional action in 1921. The plant will be enlarged and put back into operation at once for the manufacture of "Kelpchar" (a decolorizing carbon of very high activity), potash salts, and iodine. Dr. J. W. Turrentine, who was in charge of the plant throughout the period of the experimentation, after turning over to the Government's successors the manufacturing data established there, will return to Washington, D. C.

Carbon Black from Natural Gas in 1921

THE carbon-black industry is an economic factor in the development of new gas fields. This industry can easily be successful in new areas that are sparsely populated and at long distances from markets and that present other unfavorable conditions. Its one requirement is a sufficient supply of natural gas, and in fact an isolated area where there is a sufficient supply of natural gas is an ideal location for carbon-black plants, because there is no domestic demand for the gas. The best illustration of the carbon-black industry as an aid in the development of new and remote natural-gas fields is furnished by the Monroe field in Louisiana. About five years ago only a few wells had been drilled in that field in an unsuccessful search for oil. Owing to its remoteness from large cities and communities there is little demand for the gas for domestic use, and this field has therefore been a fertile one for the carbon-black industry, as shown by the quantity produced there.

In the interest of conservation the Department of Conservation of Louisiana has formulated rules requiring the extraction of gasoline from the gas before the gas is burned in the carbon-black plants. As a result most of the carbon-black plants are operated in conjunction with the gasoline plants. The gas used in the carbon-black plants in the northwestern part of the field is too low in gasoline vapors to warrant their extraction. In West Virginia and Wyoming also the gasoline is recovered from some of the gas that enters the carbon-black plants.

Owing to the depression in the rubber industry during the early part of 1921 the price of carbon-black at that time declined to about 8 cents a pound and some was sold at even lower prices. By July 1, however, the price again advanced, and by the end of the year it reached 10 and 11 cents a pound. At present there appears to be a shortage, which in some places is causing prices to range from 12½ to 15 cents. The rapid return to normal conditions in the latter part of 1921 has probably removed most of the product in storage.

As natural gas is pre-eminent as a domestic fuel, much has been done to conserve it for that use wherever possible. The drastic legislation against the carbon-black industry that has resulted from the desire to conserve the gas has forced the industry out of some States entirely and has had a tendency to retard its expansion.

The industry showed marked progress in 1921, the estimated total output being 14 per cent. greater than in 1920. The following table, which shows the output by States, is based on reports from nearly all the operators.

ESTIMATED PRODUCTION OF CARBON BLACK FROM NATURAL GAS IN THE UNITED STATES IN 1921 BY STATES

State	Number of Plants	Carbon Black Produced				Gas Used (M cubic feet)
		Pounds	Value	Average price per pound (cents)	Average yield of carbon black per M cubic feet (lbs.)	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]						
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

The outstanding features of the carbon-black industry in 1921 were the increase in production of 67 per cent. in Louisiana and the decrease of 10 per cent. in West Virginia, as compared with 1920. The center of the carbon-black industry is thus definitely placed in Louisiana. In the earlier days of the industry the center of production was in Pennsylvania, but afterward it shifted to West Virginia, which was long the leading producer. Then, as the supplies of natural gas in the eastern fields declined and new fields were developed in Louisiana, the carbon-black industry migrated to the new territory, where the supply of gas was large and cheap. The year 1921, however, was the first in which Louisiana contributed the greater part of the production in the United States. In Oklahoma, where production had ceased in 1920, one plant was operated in 1921.

Owing to the development of abundant supplies of natural gas Wyoming also attracted the carbon-black industry and became a large producer, but legislation has dealt a severe blow to the industry in that State, as is clearly shown by the large drop in production.

The average yield of carbon black per thousand cubic feet of gas consumed was slightly lower in 1921 than in 1920, although the efficiency of some of the plants had been materially increased. The yield in 1921 ranged from 0.2 to 3.5 pounds, and the maximum was 1.5 pounds higher than the maximum in 1920.

Uses

Although carbon black is used for many purposes, it is especially adapted for use in the manufacture of printer's ink, which, according to opinions of those engaged in the industry, consumes approximately from 20 to 25 per cent. of the total output. About 30-35 per cent. is used in the rubber industry, where it serves chiefly as a reinforcing agent. Carbon black is also employed for a great many miscellaneous purposes, such as the manufacture of stove and shoe polish, paints and varnishes, phonograph records, black leather, bookbinder's board, buttons, carbon and other black and gray papers, typewriter ribbons, carriage cloth, celluloid, electric insulators, cement colors, crayons, drawing and marking inks, artificial stone, and black tile. A considerable quantity of carbon black is exported to be used for similar purposes abroad but more especially for printer's ink.

Within the next two months twenty-five men will graduate from the School of Agriculture of the Pennsylvania State College in the general field of biological chemistry. These men have specialized in biology, foods and dairy chemistry under Professor R. Adams Dutcher and are at present desirous of getting in touch with manufacturers or laboratories with a view to securing locations leading to positions as research chemists, control chemists, managers or superintendents. All of these men have had a thorough training in theoretical chemistry, including a fair knowledge of physical chemistry, and all are thoroughly familiar with analytical chemistry. All interested should communicate with Professor R. Adams Dutcher, Pennsylvania State College, State College, Pa.

The Delta Natural Gas Co., capital $10,000,000, New Orleans, La., has been organized to pipe natural gas from the Monroe field to New Orleans, 250 miles distant, and intermediate towns. At New Orleans the gas will be turned over to the local gas company.

Aspects of Prohibition Law Enforcement

By R. A. Haynes

Federal Prohibition Commissioner

IS IT true that the job of enforcing the prohibition law has become the most difficult task of the hour? This particular law has behind it nearly a century of education and agitation; it has become part of our Constitution over the veto of a President; it was ratified by 46 States, the largest number of States that has ever ratified a constitutional amendment. Remembering the courage and persistency of those who had enacted the law, I determined to consecrate myself to the task of making their dream come true. So it was that I sat down with the great problem that I felt must be solved.

The Problem Analyzed

In my reorganization of the prohibition law enforcement machinery the problem confronting me assumed a three-fold aspect, viz., (1) unwarranted withdrawals which in the calendar year 1920 amounted to nearly 12,500,000 gallons of red liquor; (2) the large amount of alcohol diverted to beverage purposes through fraudulent manufacturing concerns and the large releases of beer of excessive alcoholic content, and (3) the enormous quantity of liquor then smuggled into the country along our land borders and shore lines. This three-fold problem was so large and the enforcement machinery so inadequate that it became apparent from the beginning of my administration that all effort must be concentrated upon a single phase of the problem at a time.

Mechanical Whiskey

The first effort was directed at the enormous releases of red liquor presumably for medicinal purposes. It must be remembered that 24 States out of the 48 in the United States are medicinally dry. There are approximately 150,000 physicians in the United States, and about 40,000 of them reside in these 24 medicinally dry States. Of the 110,000 physicians remaining, less than 35,000 hold permits to prescribe liquor; and yet, as one paper described it, there was a "deluge of booze."

To cut down this unwarranted flow of bonded liquor was by no means an easy task. It did not mean to wage warfare upon the conscientious physician or the legitimate druggist, but it did mean to face a powerful combine of corrupt forces who through duplicity, bribery, and every other device known to the illicit traffic, were securing large withdrawals of liquor to be diverted for beverage purposes. To correct this miscarriage of the law required the dismissal of Government agents and the indictment of some men holding high offices of trust. It meant the perfecting of our permit system and sleepless vigilance on the part of the loyal officers of the Government.

It is now nearly 10 months since the renewed effort began to restrict good liquor into legitimate channels, and I am happy to report that this result is perhaps as nearly achieved as possible. The years immediately preceding prohibition showed an annual consumption in the United States of about 130,000,000 gallons of American-made whiskey. During the calendar year 1920 there were withdrawn on permits approximately twelve and one-half million gallons and in the calendar year 1921 withdrawals amounted to about three and one-half million gallons. Withdrawal for this calendar year on the basis of the last three or four months will amount to about 2,000,000 gallons, which is perhaps only about one-half million gallons in excess of normal medicinal requirements.

The release of liquor in Philadelphia alone at the present withdrawal rate is just about one-fifth of what it was 10 months ago, and in the city of New York, in less than 3 months, under rigid supervision, regularly released liquor became restricted to practically legitimate uses. How nearly we are accomplishing the task of restricting bonded liquor to bona fide uses can be gleaned from the fact that of all the liquor seized by Government agents at the present time, less than 2 per cent. is found to be high-grade liquor, revealing the fact that the bootlegger is unable to obtain bonded spirits. Ninety-eight per cent. of the illegally obtained spirits is positively dangerous to health and often life itself.

Industrial Alcohol

The next phase of the problem to be attacked was the large amount of industrial alcohol being diverted to beverage purposes. There was apparently a combination whereby large quantities of alcohol used in the manufacture of synthetic whiskey were marketed at enormous profits. This activity constituted a formidable opponent of the Government, for you must remember that many of these men were schooled in devious methods of evading the law.

Eight or nine major violators in this classification already have been apprehended. Seizures have been made wherever warranted by the evidence and all the offenders are being prosecuted vigorously, and it is safe to say that the differential or prohibitive tax assessed against three violators alone will amount to more than $6,000,000. Governmental restrictions have been so placed around operating plants conducted according to law that the problem ceases to be longer serious.

Beer

At the beginning of this fiscal year there were approximately 500 breweries engaged in the manufacture of near-beer. Word was received from every side that many of these breweries were not obeying the law; 285 of them have been reported for violation of the law; 95 of these plants are now under seizure by the Government; 60 breweries have been seized since July 1. Two of these breweries have submitted offers in compromise of $96,000 each and the other offers reach from $20,000 to $60,000, and this does not mitigate possible criminal liability against the companies.

I have long been persuaded that fines against large violators are but very small deterrent forces, so we are citing on criminal informations in the United States courts all breweries found guilty of violations. We are not only revoking permits of the guilty, but are also refusing to reissue permits to persons who have violated the provisions of their permits, and this has resulted in the closing down of about 50 near-beer plants in recent months.

Smuggling

Smuggling is not a new art, and the smuggling of liquors into this country was not new with the coming of prohibition. The fabulous revenues to be gained made strong appeal to unscrupulous men, and the traffic in smuggled liquors soon appeared as a menace that threatened to engulf the whole program of law enforcement and was the third phase of the program. It was necessary to enlarge the forces along our borders and to augment the general agents' force that had particular contact with this phase of the work.

Early in the administration it seemed wise to make representations to the commissioners of Canada and an invitation was accepted to enter into a conference with the liquor commissioners from several Provinces. On November 1, 1921, the representatives of the attorneys general and the commissioners from the various Provinces met the representatives of the prohibition unit at Saskatchewan. Another conference was held at Detroit.

The result of these meetings was that the Canadian officials have given to our Government the utmost possible co-operation in our efforts to close the border. The Canadian law permits exportation. Our law prohibits importation; therefore the difficulties are peculiarly complicated. However, at the present time the smuggling of liquor from Canada is having careful attention and is admittedly under better control than ever before.

A most careful and thorough investigation has been made of the liquor smuggling from the Bahamas and the Indies. We are in possession of all the hideous facts concerning the smuggling traffic. We have discovered the ships and their owners, their methods and their sea routes, and we are today attacking this problem by means of an air service and a marine service. I hope the time is not far distant when we shall have such treaties with these friendly nations who are our neighbors that their subjects or citizens will no longer be permitted to commit the unfriendly act of rendering assistance and comfort to the outlaws within our country who are engaged in a business that violates the Constitution and the laws of the land.

Respect for Law the Foundation of Civilization

Nothing can affront the American people more than the statement that we can not enforce our laws. In this statement lies the death warrant of the Republic, for this Nation can not endure without reverence for law, without the recognized authority of law. If the laws passed by Congress are no longer binding upon the people, and if the executive power of our Government entrusted with the enforcement of law is powerless, where shall we look for the seat of government?

The perpetrators of this new treason have overlooked one of the great essentials of the American people—that law is but an expression of the Nation's will—and the will power of America has ever met apparently insuperable difficulties and changed them into world-amazing achievements. It is no mere expression of pride to say that when America wills to do that which other nations have not done she will not fail of that achievement.

Let us confess that the Eighteenth Amendment leads the way for all the nations of the earth in moral achievement; that America is the pathfinder for the race in this legislation; but also let us remember that the majority has spoken and that American backbone is as strong today as it was when the world laughed at the experiment of independence or scorned the prophecy of Lincoln or doubted the dream of Roosevelt of the Panama Canal.

Casale Catalytic Apparatus for Ammonia Synthesis

THE organization of an American company by men long identified with lime-nitrogen manufacture to exploit the researches of Luigi Casale, as noted on page 166 of this number of CHEMICAL AGE, lends interest to Casale's description of the catalytic apparatus devised by him for the synthesis of ammonia.

It is known that to effect the synthesis of ammonia, a mixture of nitrogen and hydrogen in theoretical proportions of three volumes of hydrogen and one volume of nitrogen is made to pass through a tube containing a catalytic substance heated to a temperature of from 400-600° C, in accordance with the equilibrium equation, $3H_2+N_2=2NH_3$. The percentage of mixture which combines to form ammonia by contact with the catalytic substance increases with the increase of pressure, and therefore the synthesis is usually made at a very high pressure, from 100 to 1000 atmospheres.

However at the high pressure of catalysis, only part of the gaseous mixture is combined and consequently it is advisable, after the ammonia formed has been removed, to cause the hydrogen and nitrogen not combined, to pass again over the same catalytic mass, in order that a new quantity of them may be combined. That is to say a circulation of gas is established during which the ammonia formed is eliminated, e.g., by means of cooling the gaseous mass. The losses due to combination are replaced with always new quantities of nitrogen-hydrogen mixture, so that the pressure in the circuit shall not diminish. It is of interest to note that the amount of ammonia obtained per hour also is proportionate to the volume of the catalytic substance.

An apparatus of the most simple and most practical type now existing consists of an external tube with thick walls, intended to withstand the pressure of the gases and of an internal tube with thin walls intended to contain the catalytic substance. Around the internal tube, i.e., between these two tubes, is placed a resistance spiral which serves for heating. The cold gaseous mixture passes first into a heat recovering apparatus, in which it becomes heated at the expense of the hot gas issuing from the catalytic tube. Then after passing between the heating spiral and the tube containing the catalytic substance, and having thus attained the temperature of catalysis, it passes along the catalytic space.

The proximity of the heating spiral to the pressure-withstanding tube presents, however, a serious drawback. A part of the heat energy produced by the spiral is communicated directly to the external tube, maintaining it at a high temperature. It is known that hydrogen under pressure at a temperature of over 400° C. deteriorates all common steel, rapidly diminishing its power of resistance, and renders it unserviceable. Considering the high cost of these tubes, which generally weigh several tons, this entails a considerable economic loss. Furthermore it may constitute a menace to the safety of the workmen detailed to the work.

Construction of Catalytic Apparatus

To obviate these drawbacks and to simplify the operations involved in the catalysis, Casale has devised a new apparatus,* which, as will be seen from the accompanying diagram, consists of the following principal parts:

1. An external tube 4 with thick walls, closed at the ends by strong plates 13, 13' the whole of special steel and intended to withstand the pressure of the gases.

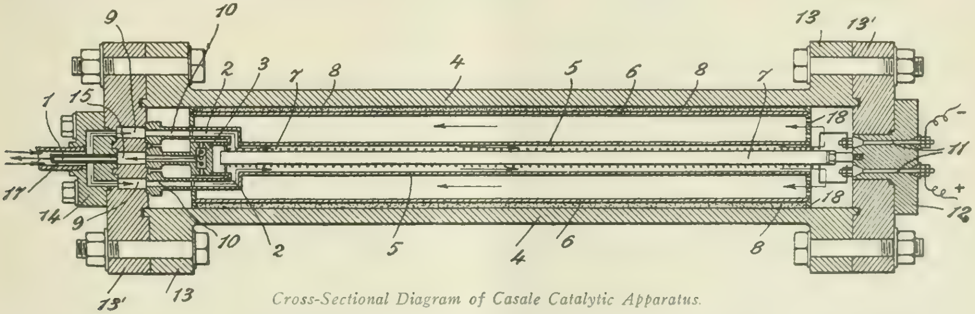
II. Two concentric iron tubes 5, 6 having thin walls, inside of the tube 4, and so joined as to form a hollow annular tube intended to contain the catalytic substance in the annular space and the heating device, shown as a resistance 7 in the internal cylindrical space.

The annular tube is covered on the outside with a heat-insulating material 8, partially shown in the diagram.

III. A special arrangement, 17, on the left end of the apparatus, described in I, with the entrance passages, 7, 10 and 2 and exit passages 3 and 15, of the gases.

The heat recovery apparatus, of which the diagram shows only one end, consists of two concentric tubes, one internal with thin walls and one external with thick walls. The mixture of gases arrives in the catalytic apparatus through the annular space between tubes 1 and 17, and leaves it flowing in the opposite direction through the internal tube 1. In this manner the cold gases passing through the heat recovery apparatus before entering the catalytic apparatus, become heated at the expense of the heat transmitted through the thin walls of tube 1, by the outgoing hot gases.

IV. In the central part of plate 13′ is a steel stopper 12, upon which is screwed the tube supporting the heating resistance spiral 7, and through which pass the insulated conductors 11 of electrical energy.



Cross-Sectional Diagram of Casale Catalytic Apparatus.

The gases flowing from the external passage of the heat-recovery apparatus 17, through 9, 10 and 2, arrive at the central cavity containing the heat resistance. They pass along the heat resistance, through the perforated plate 18 and then through the catalytic substance; thence through the holes shown in space 3 of the diagram, returning by way 15, to the internal passage 1 of the heat recovery.

The gaseous mixture partially transformed into ammonia while passing through the catalytic mass becomes cooled in flowing through the heat recovery apparatus and enters at last into cooling apparatuses where ammonia is condensed in a liquid state and as such eliminated from the circulation. Hydrogen and nitrogen not combined are sent back into the external passage of the heat recovery apparatus and then into the catalytic apparatus with a new mixture equal to the one already transformed into ammonia.

This apparatus has three essential characteristics: The heating of the catalytic mass from the center of the apparatus. This arrangement offers several advantages: first, it affords a better utilization of the heat generated by the electrical resistance, the heat acting without dispersion directly upon the gases and upon the catalytic substance through which the gases will have to pass.

But the most important feature is that, by this arrangement, the external tube intended to withstand pressure is subjected to a very indirect heating through the catalytic mass and through the stratum 8 of insulation, so that its temperature will always remain far below that at which the compressed hydrogen would deteriorate the steel and render it unserviceable. Moreover this arrangement permits the utilization of a maximum capacity of the pressure-resisting tube as space for catalyzer, since for obvious geometrical reasons it is easier to diminish the space occupied by the electrical resistance, when this is placed on the inside of the catalytic mass, than it would be if the electrical resistance were placed on the outside of the tube containing the catalyst, between it and the external pressure-withstanding tube.

Lastly is the advantage of the ease with which the resistance attached to the stopper in plate 12, as described in paragraph IV, can, if necessary, be taken out and changed.

The arrangement as set forth in paragraph III for the entrance and exit of gases at the same end of the catalytic tube, and which, by joining the heat recuperator with the entrance and exit passage of the gases through plate 13, permits the hot gases, issuing from the catalytic space, to flow through the internal passage of the heat recuperator. Accordingly its tube will not be subjected to pressure inasmuch as the pressure from the incoming gases on the outside will counterbalance the pressure of the issuing gases on the inside. This is a considerable advantage considering that hydrogen at the high temperature of catalysis would deteriorate the steel of the tubes, diminishing their power of resistance.

The independence of the tube containing the catalyst, both from the pressure-withstanding tube and from the resistance, facilitates the work incidental to the change of the catalytic mass.

To John H. Graff, of the research department. The Brown Co., Berlin, N. H., is the credit for the proposal of an association of technical men for the promotion of arts of industrial photography and microscopy. To discuss this subject together with the project of an exhibition, a meeting of technical men was held on April 10, at the Waldorf-Astoria, New York, under the chairmanship of Mr. Graff. Charles F. Roth, comanager of the National Exposition of Chemical Industries, attended and promised his cooperation to assure the success of the exhibit in connection with the forthcoming exposition. Another meeting will be held on May 10, at 2 P. M., at the Chemists' Club to consider the subject further.

---

*U. S. Letters Patent No. 1,408,987, issued March 7, 1922.

Selling Research

By C. E. Skinner

Assistant Director of Engineering
Westinghouse Electric & Manufacturing Co.

JUST what do we mean by the term "Selling Research"? And why should not research results of value be eagerly sought and used by all who have a place for them? Why should anything like a selling campaign be necessary to market research results? If selling is necessary what rules should be followed in making the sale? Who become the customers? And do the customers have to make a resale? I am not at all certain that I can answer these questions to my own satisfaction, let alone to yours. If I succeed in showing you that selling research is a real research problem, I shall have accomplished at least a part of my purpose.*

Selling research consists in convincing all with whom the research worker has to do, that his research is worth while doing, and that the results will show a gain in quality or cost or performance over the methods with which the user is familiar. The master salesman will have far less trouble than the beginner even with the same product. What is said in these remarks will perhaps apply more specifically to research in and for a large industrial organization than elsewhere, but perhaps it may apply to other phases of research as well.

The first sale to be made consists in convincing those who are responsible for the financial part of the organization that it is worth while to spend money on the research worker's scheme. Those of you who have to deal with this phase of the subject are well aware of the fact that such a sale is not always easy. Hard-headed business men must be convinced that the results will yield a return before a specific appropriation can be obtained. Those who would use the products of such a research must be convinced that the results will effect a saving or make a better device. A selling campaign is necessary therefore from the inception of the idea until it is fully commercialized. The strategy of such a campaign must be as varied as the researches themselves and must be governed by the circumstances under which the research is undertaken and by the character of the customers with which the research worker has to deal.

In a large organization perhaps the easiest selling campaign is where the results of the research are specifically requested by an individual or a group who have need for such research results and no means themselves for obtaining them. Perhaps the hardest sale to make is where a new device or a new principle is developed independent of the users, and where it requires a change in well-known methods or products to permit its use.

As a phase of the selling proposition let us consider the following: Let us assume that from theoretical considerations a brilliant research worker sees that he can utilize a new principle in the construction of a superior lightning arrester. Does every one involved in the engineering, manufacture, marketing and use of the lightning arrester enthuse over the new scheme when it is explained to them? The chances are one hundred to one that few, if any of them, do so. They may be sympathetic but they are not enthusiastic. They would like to see the scheme tried out, provided it does not involve them in any risk, but they may one and all be very backward in recommending the expenditure of money over the scheme.

The research worker must then convince the authorities that investigation in the laboratory is worth while. He must convince the engineers that laboratory results correspond to theory and show them that a practical construction is possible. Practical designs must be made and field trials arranged for. Assuming these successful, manufacturing authorities must be shown that manufacture is feasible and profitable, and the sales force convinced that the new device is something the customer will buy and use. It is perhaps only a truism to say that a salesman can not sell goods in which he does not believe and it is certainly true of goods he does not know or understand.

Finally the salesman must convince the customer that the new device is better than the old, and to do so he must go back to the principles underlying its operation which were those used by the research worker in effecting the first sales in this long series. It is, of course, not always necessary for the research worker to carry out all this sale program, but I think you will recognize that a program such as that outlined is necessary in many cases.

As stated, one of the difficult sales to make by the research worker is that which involves factory processes. How often does one hear the complaint that those who are to use a new process or material spend their energies in showing why the new scheme will not work rather than trying to make it work. This attitude while still existing, is, I think, far less prevalent, at least in our own organization, than formerly, due to a far more sympathetic attitude between the salesman and the customer; in other words, between the research worker and the factory man. There is a natural and perhaps not altogether unfounded suspicion on the part of workers' executives and the workmen themselves that new ideas and new processes from the outside will get them into trouble, and a single failure on the part of those exploiting such matters will be remembered much longer than many successes.

Examples almost without number could be cited to maintain my thesis, that selling research products is one of the very important phases of research work. But perhaps enough has been said to illustrate the points in mind and to show that like research itself, no two selling propositions can be handled in identically the same way, and it is therefore necessary to consider each scheme on its own merits. It may be said, however, that in general, the best method of sale is for the research worker to take his customers into his confidence at as early a date as possible and keep them advised as to the progress of his results, and keep them in contact with his methods of work so that they will have confidence in the results which he produces. In other words, to sell research results to advantage a sympathetic contact between the research worker, his work and his customer must be established and maintained until the scheme is fully commercialized.

J. G. White Engineering Corp., 43 Exchange Place, New York, has the contract for the erection of a one-story 40x60 powerhouse for the General Chemical Co., at Baltimore, Md.

---

*[illegible] the Engineering Division, National [illegible]

Peter S. Gilchrist.

Peter S. Gilchrist

An Englishman to Whom the Chemical Industry of the South Owes Much

CHEMICAL
AGE

Volume 30
Number 4

April
1922

A Consolidation of
The Chemical Engineer
and Chemical Age

EDITORIAL

HOWEVER painful hard times may be in its repercussion in unemployment, reduction of living standards and the lowered morale following upon the waste of war, if man will profit from the lessons that it teaches, we can understand what Shakespeare had in mind when he said: "Sweet are the uses of adversity."

The lesson that stands out from the experience from which we slowly are emerging is that of the essentially co-operative nature of society and the evil of the anti-social conduct of those who would subordinate the general interest to class advantage. Not alone the perpetuity of our institutions but the welfare of each demands that this lesson be brought home to those who by their conduct make recuperation difficult.

In high places and low, in domestic affairs and in our international relations, are influences that deny the beneficence of this lesson, with the result that progress in industrial activity is slower than it otherwise would be.

The uncertainties incident to the artifical restriction of international trade; blackmail to the tune of billions; governmental meddling in private enterprise; taxation, municipal, state and federal, of a volume and of an incidence that powerfully is repressive of enterprise and hence of the well-being of the people; not only tribute levied by organized labor in a special advantage that injures all labor but today in a basic industry an attempted aggrandizement that savors of civil war, are reflections of our political system and of the methods of organized selfishness that make many at times to despair of the efficacy of democracy in the government of men.

Well may we turn again to that same fount of wisdom to say: "To wilful men the injuries that they themselves procure must be their schoolmasters."

COMMERCIAL bribery means tipping the men who influence purchases. Like all tips the cost comes out of the consumer.

The system is a product of the degradation of competition, which, in its translation, in many lines, from the commodity to the container, to premiums, to prizes, to the personality of the salesman, to secret commissions, or to extraneous fields unrelated to quality or service, is a phenomenon of the growing standardization of goods and of production facilities illy geared to the requirements of consumption.

Commercial bribery in its many forms is an evil of staggering proportions, long practiced and suffered, which hard times have encouraged traders to correct. The real motive, however, for organized effort to educate the public to the wastefulness of the system is the fact that, with reduced margins of profit, the cost began to be thrust upon the producer with corresponding sacrifice of capacity for public service. If the manufacturer cannot make a profit the public suffers, if the service is needed.

Aroused commercial sentiment in several states has secured legislation penalizing corrupt trade practices. The evil, being of national extent and weed-like in its growth, demands national legislation, not that men can be made moral by law, but that an ideal of honest business may be registered.

The Commercial Standards Council, 19 Park Place, New York, composed of representatives of many trade associations, deserves, in the promotion of such legislation, the support of every business man who alone is powerless to correct this evil.

DR. VAN. H. MANNING, director of research, American Petroleum Institute, in collating the problems of petroleum technology demanding the attention of chemists and engineers for their solution, has established a precedent that well could be followed by every trade organization.

Manufacturers are encouraged to co-operate, but forbidden to combine in any way that can be interpreted as restraint of trade. Co-operation recently has been notable in the field of distribution, with forbidden excursions into the domain of price maintenance. Co-operation in the solution of common technical problems whereby production costs may be reduced and the consumer benefited by lower prices, would be an aspect of association activity that would mark a distinct step in industrial progress.

The government research laboratories in an impersonal way work for all industry and suggest the service of a research institution devoted to the solution of the common problems of a single industry, such as is performed, for example, by the Mellon Institute of Industrial Research, for corporations and certain trade associations.

What is practicable and desirable is the listing, as has been done by Dr. Manning for petroleum technology, of the common technical problems of each industry, that progress in their solution may be encouraged by acquainting all qualified to attack them to undertake their solution.

A CHEMICAL manufacturer reports that distrust of chemists has arisen because of violations of confidence in the use of information acquired in plant experience, and suggests the need of well-defined standards of professional conduct—a code of ethics—"and perhaps an enforcement organization as other professions have." This subject, long discussed in CHEMICAL AGE, assumes added importance to both employer and employe in the compulsion of consideration imparted by a manufacturer's recommendation.

The reader is urged to analyze the thought in the article, "Some Economic Aspects of the Practice of Chemistry," on page 177, and to view here as in a mirror a brief but fairly accurate reflection of the experience of every production chemist.

The chemical novitiate is a sponge for information; he feels keenly the need of practical experience, for upon that is based his earning power in an industry wherein secrecy in procedure often is a surer safeguard to special advantage than a patent, and in many cases can be the only protection. In dissatisfaction with salary and a higher one offered by a competing manufacturer, or with the latter as a condition precedent, or from any cause that promotes migration in employment, we have a common process in the standardization of procedure in a field of production wherein the personal equation ranks high.

The manufacturing plant is a school to the young technical man in which he pays for the instruction of experience. In the operation of natural selection in industry he is a shifting character usually until he finds the job that is the measure of the man. Only rarely do men find their opportunity in a single organization. Loyalty to the corporation that pays the wage, which means giving to the organization the best that is in him, embraces a circumspection that the man's character alone will dictate.

The consideration of matters here indicated is a prime function of the professional economic organization of industrial chemists, not existing as a subsidiary or a wheel within the wheel of our scientific society, but as an independent institution dedicated to the study of the material problems of its members.

LIMITATION of individual initiative on the part of employes possessing valuable information in virtue of their employment, has been the subject of numerous court decisions which obviously have little influence in retarding a natural process in industrial development. Chemists are keen to acquire practical experience in the urge for growth; keenness in selling to material advantage what they know comes only with years and the inevitable mistakes.

We wish to emphasize here the wisdom of the chemical manufacturer's recommendation of a professional economic organization of chemists, by chemists and for chemists; and submit as a commentary on the incapacity of chemists as a class to look out for themselves, that the employer himself suggests such segregation.

Chemical raw material producers have their trade organizations; chemical manufacturers in their various lines have theirs; chemical equipment manufacturers are in process of organization; chemical salesmen have their trade organization; consumers of chemical products sit in trade assemblies in which the raw material situation is not neglected, in all of which the Golden Rule is recognized despite the wiles of men in a wicked world.

What is good for the boss is good for the hired man in an industrial situation, wherein, if such segregation of capacity, inculcation of standards of practice and enforcement of professional control of the practitioners and their opportunities in industry, are not encouraged to accomplishment, complaints of the type we have noted will be of more frequent occurrence.

An independent professional economic organization of chemists, managed for industrial chemists by representatives of the three grand divisions of individual activity in chemistry, viz., the teaching chemist, the production chemist and the business chemist, has a field of usefulness to the chemist and to chemically controlled industry that commands the earnest favor of every chemically trained man.

TO relegate the scrutiny and promotion of the chemically trained man's material welfare to an organization of employers, or to confine it to a scientific society dominated by special interests, or to discourage this wholesome activity by chemists themselves in a separate professional economic organization, is a positive perversion of the natural processes of growth.

The questions of duplication of effort or division of interest have no place in a discussion wherein the end aimed at is increase of opportunities for exercise among a class that needs such exercise, in a system that should magnify men and would set up the fetich of management to facilitate the purposes of a few. Men can not get experience for nothing.

Economic law works for integration in industry, but human experience teaches that concentration of power in the hands of the few always breeds evils. As regards segregational activities these evils embrace, among others, nepotism in all its insidious forms; recognition and encouragement of secret organizations within the "one big union"; development of a small class of chemical politicians with all that it means in the ambitions of men; maintenance of control by a group that reflects popular opinion only under compulsion and which perverts its control to the promotion of private interests.

No class of technical men is increasing at greater rate than chemically trained men. That a single organization of catholic membership can encompass the varied instrumentalities of service to this class, in a field so intimate and embracing as chemistry, is not only impracticable, but to urge it is an affront to men who believe not only that there shall be rivalry in service, but that there shall be that specialization of function essential to efficiency.

A Cheap Way to Make Printing Ink

PRINTING and lithographing inks, in general, are composed of a suitable oil or varnish or both, carrying a desirable pigment. Other materials sometimes are added to impart body or to hasten drying. For example, linseed oil, turpentine, chinawood oil (tung oil) may be used as drying oils for these inks, the drying occurring by oxidation of the oil. Dilution of the ink by increase of the amount of drying oil is expensive because these drying oils are expensive, and the cheaper non-drying oils are not effective.

Dr. Harry N. Holmes and Donald H. Cameron, of Oberlin University, have been granted a patent* on the ink and the process of making it whereby such inks can be diluted with a cheap liquid, thus reducing the excessive cost due to drying oils and other substances usually used for this purpose, but without impairing the consistency or quality of the working body and without deleterious effect upon the drying qualities of the ink. One essential characteristic of Dr. Holmes' ink is the incorporation into the oily body of the ink, of water or some other suitable cheap liquid, this emulsification being effected by the use of gum dammar as the emulsifying agent. This material is a resinous exudation of certain tropical or semi-tropical trees and is usually classed as a varnish or lacquer resin.

Dr. Holmes and his colleague have discovered that the use of gum dammar makes possible the production of successful and practically permanent emulsions of the "water-in-oil" type, i. e., emulsions of which finely divided drops of water or some other liquid of the "water" type, such as glycerin, or solutions of glycerin, or solutions of liquid or solid material in these substances, or even suspensions of solid particles in these substances, are examples. The oily body of the "water-in-oil" emulsion may be one or more of various oils, fats, greases, waxes and also many organic liquids, such as benzene (benzol), toluene, carbon tetrachloride, carbon disulphide, petroleum, or its fractional distillates or residues, chloroform, or other suitable liquids that will dissolve gum dammar but which do not react harmfully with it.

As the result of emulsification minute drops or globules of water are dispersed in the ink and stabilized in that condition by the action of the gum dammar. These finely divided water drops act somewhat as solid material. Thirty per cent. of water drops in an ink paste causes little change in the body of the paste if the water is broken up into sufficiently fine particles. By the use of inks prepared in this manner the amount of oil necessary is very materially reduced, with a consequent material reduction in cost. Each drop of water is surrounded by the oil or varnish body and therefore does not come in direct contact with the printing type or parts of the press or lithographing equipment or with the paper. The oily body carrying the pigment dries and allows the water to evaporate through the dried or drying oil film. The working body of the ink is not harmfully affected and rapid drying of the oil is not hindered. No material of harmful or undesirable nature is added to the ink, because gum dammar is a proper ingredient of inks and without harmful effect.

The following directions are given for the preparation of a sample of ink of this class:

Two grams of gum dammar are dissolved in a small amount of benzol as a convenient method of getting the gum dammar into solution and distributing it through the oil ink body. This gum dammar-benzol solution was then added to twenty grams of an ordinary carbon black varnish ink having an oily body and was thoroughly mixed with it. The benzol was then allowed to evaporate. This produced a thorough distribution of gum dammar throughout the ink body. Ten grams of water were then thoroughly incorporated into the ink by mechanical agitation, whereby the water was reduced to very finely divided drops or globules distributed throughout the ink body, producing a good emulsion of water drops in an oil varnish body.

The product thus obtained was found to be stable upon standing, no appreciable separation of water being detected after a considerable time. This ink, containing 33 1-3 per cent. water, possessed as good a body as the original sample and was found to work equally as well on a printing press. The color of this particular sample was of course less intense due to the dilution, but additional amounts of carbon black or any other pigment readily can be worked into the body of the emulsified ink, either before or after the emulsification, to obtain any desired strength of color.

A Call for Chemists in Government Service

The United States Civil Service Commission invites attention to examinations to be held on May 24 and June 21 to fill positions of junior chemist in the departmental service at Washington, D. C., at entrance salaries ranging from $1,200 to $1,800 a year.

Heretofore, the junior chemist examination has been of the unassembled type; that is, it did not require that applicants be assembled for a written examination, but provided for a rating on education and experience, consideration being given to the number of semester hours devoted to study of the profession. Also, this old type of examination included 15 optional subjects covering that many special branches of chemistry.

The examinations now announced require written tests in the examination room in addition to a rating on education, training and experience. This new type of examination includes only four optional subjects, namely, advanced inorganic chemistry, organic chemistry, analytical chemistry, and physical chemistry, the four principal subdivisions of chemistry. This change in the number of optional subjects should be of especial interest to recent graduates for the reason that the average collegiate course does not specialize much beyond the four principal subdivisions named.

In the new examination, the applicant will be given an opportunity to select the particular branch or branches of chemistry that he desires to follow. Service with the Government as a junior chemist, therefore, may be regarded as postgraduate study with a view to further specialization. It is only required in advance that applicants give reasonable evidence that they are properly qualified to follow the particular lines of chemistry selected.

Further information regarding the pending examinations and application blanks may be obtained from the United States Civil Service Commission, Washington, D. C., or the secretary of the civil service board at the post office or customhouse in any city.

John M. Bailey, for more than 30 years secretary, Pittsburgh Testing Laboratories, has resigned to become vice-president-secretary, Standard Inspection Co., Bessemer Building, Pittsburgh, Pa.

---

*U. S. Letters Patent No. [illegible] issued March [illegible]

The Hydrogenation of Naphthalene

Tetra and Decahydro Naphthalenes as New Industrial Products

By R. G. Furness, M.Sc.

ELIMINATION of waste in its strict entirety embraces the development of applications of materials available in excessive quantities as by-products of industrial operations. The supply of naphthalene greatly exceeds the demand, and although this hydrocarbon serves as the starting material for the production of phthalic anhydride, by the old German method or by the newer American catalytic methods, the use of this derivative, important as it is as the progenitor of a valuable class of dyestuffs, is limited. Smaller uses of naphthalene consume relatively little, and, in short, the greater part of the hundred million pounds or more of naphthalene annually produced in America is available for assimilation in industry, *per se* or as a derivative.

Attempts to use naphthalene as a motor fuel were made during the period of shortage due to war conditions in Europe, but little success attended these efforts; and the same may be said with respect to the attempt to produce lubricating oils from naphthalene. By the hydrogenation of the hydrocarbon, however, liquid derivatives are obtained which are capable of a wide application in industry. The tetrahydro and decahydro naphthalenes have been known for some considerable time, but it is only within the last few years that their commercial possibilities have been studied, and their preparation on an industrial scale effected. Shortage of solvents, motor fuels, etc., in the blockaded Germany of wartime contributed in no small degree to the efforts of the German technologists to translate established reactions to a manufacturing basis. The success with which their efforts have been met is attested by the fact that the Tetralin G. m. b. H. has erected a plant at Rodleben near Rosslau capable of manufacturing 100-120 tons of "tetralin"—tetrahydro-naphthalene—per day.

The products of naphthalene hydrogenation have had a wide application and this is only slightly diminished in post war days— at any rate in Germany. Two of the principal applications of tetralin, viz., as a turpentine substitute and as a component of motor fuel, will possess but slight attraction in America, since natural turpentine and motor spirit are more cheaply available, but we must remember that conditions are different in Europe, and tetralin will prove a strong competitor to American turpentine.

Of muct greater interest in this country, however, is the important role which tetralin will play in the production of dyes and fine chemicals. The tetrahydro derivative possesses one benzene nucleus unhydrogenated, and therefore capable of substitution by means of halogens, hydroxyl and nitro groups, alkyl and acyl radicals, etc., just as in the case of benzene itself. The infinite number of possible derivatives will contain many of technical importance; already it has been shown that important dyestuffs can be prepared from tetrahydro-naphthalene. If, as is very probable, this derivative can be produced at a price allowing competition with benzene, there can be little doubt that tetralin will become a valuable base for development work in the color and fine chemical industry. This consideration is quite irrespective of modifications which may result in the substitution of tetrahydronaphthalene for benzene, in already known dyestuffs. The different effects capable of realization will conceivably be sought even if tetralin should cost slightly more than benzene. Tetrahydro-naphthalene should therefore possess attractions for the American chemist.

Hydrogenation of Naphthalene

It is upon the classical researches of Sabatier and Senderens, Ipatiew, Willstatter, and others that technical hydrogenation operations are founded, and this is no less true in the case of naphthalene. The hydrogenation of this hydrocarbon by catalytic processes was known long before the Tetralin G. m. b. H. took up the question. The highly creditable part played by this company's chemist should not, however, be minimized, and reference will be made later to the plant-scale hydrogenation.

Sabatier and Sendrens showed in 1901 that on passing naphthalene with excess of hydrogen over an active reduced nickel catalyst at 200° C., tetrahydro-naphthalene was easily produced, as a liquid boiling at 205° C.[1] Later, Leroux by application of the Sabatier method was able to prepare the decahydro derivative, now commercially known as "Decalin," as a liquid boiling at 187° C.[2]

Ipatiew also applied his well-known method of hydrogenation to the treatment of naphthalene. At pressure of about 100 atmospheres of hydrogen and temperature about 250° C., and in the presence of Ni_2O_3 decahydro naphthalene was produced.[3] Similarly, the naphthols and naphthoic acids can be transformed into hydrogenated derivatives.[4]

The method of hydrogenation developed with general success by Willstatter is equally suitable for the laboratory preparation of the hydro-naphthalenes. Thus, Willstatter and Hatte report[1] that carefully purified naphthalene dissolved in glacial acetic acid may be hydrogenated to the decahydro derivative in the cold, in the presence of a platinum black catalyst. The catalyst is precipitated by the ordinary Loew method, but should not be exposed to the atmosphere, but dried in a vacuum after preparation and washing. It is particularly to be noted that commercial naphthalene cannot be employed in this experiment.

Finally, Skita and Meyer hydrogenated naphthalene in a similar manner, using a platinum catalyst, with gum arabic as a stabilizing colloid. Pure naphthalene is again essential and the operations may be conducted at room temperature, acetic acid being used as solvent for the hydrocarbon.

Technical Production of Hydro-Naphthalenes

It has been noted in the foregoing that only pure naphthalene can be used in successful hydrogenation experiments. Commercial naphthalene contains, *inter alia,* the sulphur compound, thio-naphthene, which effectively prevents catalytic hydrogenation. In small scale experimentation, sufficiently pure naphthalene can be prepared by extensive crystallization, sublimation, and the like. The use of expensive solvents, or of many operative methods suitable on a small scale is quite impossible for the treatment of naphthalene in very large quantities. It is the solution of the problem of cheap, efficient and rapid purification of commercial grade naphthalene by the Tetralin Company which has rendered possible the commercial development of the hydrgenation process of Sabatier *et al.* It is therefore of interest to examine briefly the processes suggested for this purpose.

---

[3] Ber., 1907, 40, p. [illegible] [4] [illegible]

[1] Ber., 1912, 45, p. 1471.

[1] Compt. Rend., 1901, 132, p. 1257. [2] Ibid, 1904, 139, p. 672.

Purification of Naphthalene

The ordinary naphthalene of commerce shows the presence of thio-naphthene when rubbed with concentrated sulphuric acid, whereupon a red or pink color develops. It is found that purification to a standard such that no color is developed in this test is sufficient to insure successful hydrogenation in the presence of reduced nickel or other suitable catalyst.

Numerous patents have been taken out by the Tetralin G. m. b. H., covering the purification stage in the series of operations. The method in successful operation is simple and consists merely in stirring molten naphthalene at temperatures of about 150-200° C., with a small percentage of a highly absorbent substance, such as fuller's earth, kieselguhr, absorbent charcoal, talc, etc. In addition easily fusible metals such as sodium or potassium may be employed, in which case smaller quantities of the absorbent substance are required. Reduced metals, such as nickel or iron, naturally in a very finely divided condition, or substances like sodamide, calcium carbide, etc.—a metal combined with a non-acid radical—assist the purification of naphthalene up to a standard permitting subsequent hydrogenation.

After a relatively short contact with the purifier the naphthalene is filtered from, or preferably, distilled off the spent material into the hydrogenation autoclaves. The pre-treatment may have been carried out in a hydrogen atmosphere, but if distillation be subsequently practiced this is effected in vacuo.

Modifications of the above principle of naphthalene purification are possible, in which the same materials may be used, alone or in combination. Thus, naphthalene may be vaporized and passed over a layer of fullers' earth, mixed if desired with finely divided metals, sodamide, etc., maintained at a temperature sufficient to prevent condensation of naphthalene. Again, the crude hydrocarbon may be dissolved in a suitable solvent, and the solution treated at a raised temperature with the chosen purifier. The naphthalene must, of course, be recovered from solution before passing to the hydrogenation stage of the operations. It is clear, however, that the first method described is the most suitable and economical for technical purposes, advantages in control, space-time output, handling, etc., being apparent.

Hydrogenation of Purified Naphthalene

Naphthalene showing no red coloration when rubbed with strong sulphuric acid is passed to the hydrogenation autoclaves. Simple distillation from the purifying vessels directly into the autoclaves has been stated to be the most suitable procedure. A proportion of a nickel catalyst, say 5 per cent., is added and hydrogen passed under conditions of temperature and pressure of 200° C. and 15 atmospheres respectively. Hydrogenation is rapid at first, and as the reaction is exothermic little or no heat is required to be supplied to the autoclaves, if sufficient heat insulation is provided to compensate for radiation losses from the surfaces of the autoclaves.

Rapid agitation must be maintained in order to insure intimate contact between naphthalene, hydrogen and catalyst. In this connection, it may be suggested that the idea of passing the hydrogen through "Filtrose" plates before entry into contact with the naphthalene might dispense with the necessity of stirring. The extreme minuteness of the hydrogen bubbles affords a very large surface of contact for reaction, and allows of the retention of the nickel catalyst in suspension without mechanical agitation. This idea has been patented in connection with the very similar problem of fat hydrogenation in the presence of catalysts such as those used for naphthalene hydrogenation.

Many types of autoclaves are possible, and detailed description is unnecessary, but since leakage of hydrogen around glands and stuffing boxes associated with mechanical agitation fittings, is very considerable and costly to the process, some of the types in which the stirring gear, motors included, are entirely enclosed, should be very useful. This is especially the case when the operations are to be effected at pressures round 15 atmospheres, since the problem of hydrogen loss received great attention in the development of the oil-hardening process, where much lower pressures, and, presumably, much lower hydrogen losses, obtained.

Catalysts

Passing to a brief consideration of the most suitable catalyst to be employed, it may be stated generally that those found most useful in the hydrogenation of oils will be found most suitable for the acceleration of naphthalene hydrogenation. The Tetralin Company suggests reduced nickel supported upon fullers' earth, and there can be no doubt nowadays that a supported catalyst is more active than reduced nickel itself. Reduced nickel on kieselguhr was one of the earliest successful hydrogenating catalysts for technical purposes, and, although care is required in the production of any form of reduced nickel in order to insure maximum activity, the conditions are well known.

The controversy which raged between the Sabatier school and the Erdmann school upon the mechanism of catalytic hydrogenation, and the nature of the catalyst, when the latter chemist claimed the use of nickel *oxide* as fat-hardening catalyst, will be remembered. Without entering upon a discussion of the matter at the moment, it is noteworthy that a recent patent of the Tetralin G. m. b. H. claims the use of oxide catalysts, such as nickel oxide, reduction to metallic nickel not being effected. It is indeed claimed that a rate of reaction double that possible in the presence of reduced nickel catalysts can be attained when a catalyst of nickel oxide prepared, say, from basic nickel carbonate is employed. Apart from the increased rate of reaction, the difficult and troublesome preparation of reduced nickel catalysts as a separate operation, is avoided. The whole process is therefore considerably cheapened.

The important question of the life of the catalyst is determined by the efficiency of the pre-purification of the naphthalene. If the removal of thio-naphthene has been effectively carried through, the catalyst will be capable of use many times in succession without regeneration. The hydrogenation ended, the product is merely distilled from the catalyst, which is immediately covered with fresh purified naphthalene for treatment.

After a definite falling off in catalytic activity is noticed, the catalyst can be regenerated with little difficulty.

It is of course possible to produce other pure tetra hydro-naphthalene, the deca derivative, or a mixture of the two, according as two or five molecules of hydrogen—or an intermediate proportion—are absorbed per molecule of napthalene treated. The product may be separated, if necessary, by distillation or preferably by the action of sulphurous acid, which removes the unsaturated tetrahydro-naphthalene, leaving the saturated decahydro compound unattacked.

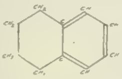
The cost of the hydrogen, of which gas up to 20,000 cubic feet may be absorbed and mechanically lost in the production of a ton of tetralin, is of moment in determining the over-all production costs. Catalyst charges and purification costs need not be heavy, and, without giving a detailed analysis of costs, it may be stated that tetralin shall be capable of production at a price comparable to that of coal tar benzol, and lower than that demanded for American turpentine in Europe.

Properties of the Hydro-Naphthalenes

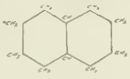
The hydro-naphthalenes are water-white, pleasant-smelling, limpid liquids, and possess the following characteristics:

	TETRALIN	DECALIN
Boiling Point	205-207° C.	185-187° C.
Specific Gravity	0.97-0.98	0.89-0.90
Flash Point	78° C.	60° C.

The tetrahydro derivative, possessing the structural formula is unsaturated, and contains still one benzene nucleus open to substitution with halogens, nitro groups, alkyl radicals, etc. It is attacked by both sulphurous and sulphuric acid, as well as by nitric acid in the formation of nitro-tetrahydro-naphthalenes.



Decahydro-naphthalene, on the other hand, is fully saturated and behaves exactly like a cycloparaffin, being incapable of forming substitution derivatives in the way aromatic compounds do, and unattacked by mineral acids in the cold.



It is therefore from tetralin that useful intermediates can be produced. Decalin is probably, however, the better general solvent and motor fuel component.

Applications

Tetralin was used extensively during the later years of the war as a component of motor fuels and as illuminating oil, in substitution of kerosene, in Germany. In the no less difficult times of post-war days, it is still being used, and helping reduce Germany's imports. Thus, the Benzene Syndicate has introduced recently a new fuel consisting of 50 per cent. benzol, 25 per cent. tetralin and 25 per cent. of 95-per cent. alcohol. This fuel, named "Tetralitbenzol," is being delivered by many mixing stations throughout Germany, and is stated to be quite suitable and acceptable. In this way, Germany's fuel supplies have been increased by many thousand tons per month.

This application can have little interest in America, for even though engine troubles are claimed to be non-existent in the case of tetralitbenzol in contradistinction to many gasoline substitutes, and the "miles per gallon" factor is high, yet natural and cracked gasoline will always be available here at a lower cost than that at which such a substitute could be produced. The potential supply to be used as successor to gasoline, when supplies of the latter are exhausted, is too small to have weight in this important matter of preparation for the future.

As a Turpentine Substitute

As tetralin can claim, at the best, no superiority to turpentine, except that its flash point is higher and it is therefore somewhat less dangerous in use, it is probable that the new derivative will not rival the natural solvent in the American paint and varnish industry.

In Germany, on the other hand, much success has been attained, and although there is still no full agreement, many empirical formulae have been developed and used with satisfaction in the paint trade. Many failures are attributed to the use of tetralin; a serious objection which is thought by some to have been entirely answered, and by others still valid, is the production of a pink color in white-painted objects, when tetralin has been used in place of turpentine in the preparation of the white paint.

In view of the probable lack of interest in this application of tetrahydro-naphthalene in America, little more need be said, and reference only given to the many papers in the *Farben Zeitung* during the past two or three years.

Solvents, Etc.

As a solvent for hydrocarbons, resins, essential oils, fats, india rubber, etc., tetralin may have slight use. The high boiling point of the hydrocarbon, however, would render difficult the recovery of the substance extracted, even if vacuum distillation were practiced. Crystallization might be possible in some cases. The application in this direction is unlikely to rival petroleum ether, benzene, chlorinated hydrocarbons, carbon disulphide, etc.

A final use to which tetralin has been put with success, but which will have little attention in America, may be briefly noted. If it be chlorinated by means of dry chlorine in the presence of phosphorus pentachloride, and the chlor derivative condensed with tetralin itself in the presence of phosphorus pentoxide, a good lubricating oil results on subsequent fractional distillation in vacuo.

Derivatives of Tetralin

It is the potential applicatin of tetralin as a source of intermediates for the dye and fine chemical industry that requires a little more attention. The un-hydrogenated benzene nucleus reacts in a manner almost identical to that shown by benzene itself. The actual manner of preparation of the large number of useful derivatives already known need not, therefore, be described. It should be clear, nevertheless, that a new hydrocarbon of unlimited reactibility will be available for the dye industry, when the hydrogenation of naphthalene is taken up in America.

The derivatives have been carefully examined both by the chemists of the Tetralin Company and by independent observers. Thus, Rowe has prepared many acyl tetrahydro-naphthalenes[1] and has found them capable of use in the production of dyestuffs. The tetrahydro-naphthalene was not prepared by a catalytic method, but by reduction of naphthalene by means of sodium in amyl alcohol. This method of production is quite impossible upon a technical scale, but it is pointed uut that if tetrahydro-naphthalene becomes available in large quantity and at a cheap rate, its acceptance by the dye industry is assured.

The sulphonic acid of tetrahydro-naphthalene is easily prepared by direct sulphonation with 100 per cent. sulphuric acid at a relatively low temperature.

---

[1] J. Soc. Chem. Ind. [illegible]

From the 2-sulphonic acid thus produced, the corresponding naphthol can be easily obtained in the ordinary manner, fusion with caustic alkalies, and subsequent acidification. Tetrahydro-naphthalene-2-naphthol is of use as a disinfectant.

The sulphonyl chlorides are likewise easily prepared, and both the 1 and 2 derivatives can be obtained in a pure state, and the corresponding sulphonic acids, amides, anilides, thio-naphthols, etc., obtained by suitable reactions. From the thio-naphthols by a simple series of reactions involving condensation with chloracetic acid, tetrahydro, thio-naphthyl indigo can be obtained.

Halogens form substitution products, just as with benzene or naphthalene, and the reactivity of chloro-tetrahydro-naphthalene already has been illustrated in one direction.

The action of nitric acid upon the hydrocarbon is of fundamental importance, and a number of mono nitro, dinitro and trinitro derivates has been obtained. It is scarcely necessary to indicate the possibilities of development here for reduction, etc., may lead to an infinite number of products. Thus, amines, azo and hydrazo derivatives, hydrovyamines, benzidenes, etc., may result on applying the usual reactions.

The use of the hydro-naphthols or the naphthylamines in the production of azo dyestuffs is of great promise; and in short, the reactivity of the unhydrogenated benzene nucleus is as yet unevplored, except for a few incursions, but these, so far as they go, have revealed a land of promise to the dye-maker.

In the realm of fine chemicals, comparatively little can be noted, but in this case, too, it is probable that different products of value can be made available. To quote but a single instance, the ethyl ether of tetrahydro-naphthol is stated to possess valuable odoriferous properties, a circumstance not unexpected in view of similar properties of the ethers of the naphthols.

The large supply of naphthalene available at a very low price can be transformed into derivatives of great potentialities. The operating costs for such conversion of a waste product into a basic raw material for dyestuffs and fine chemicals, are not large; it is probable that the price of tetrahydro-naphthalene can be brought as low as that of benzene.

In conclusion, a brief reference may be made to the "Hexalin" and its homologues, cycle hexanol, methyl cycle hexanol, etc., produced by catalytic hydrogenation of phenol, cresol, etc. These substances are finding application in Germany, in the production of all kinds of soaps, for household, laundry and textile scouring operations, and represent a similar endeavor on the part of Germany to avoid importation. The supply of tar acids does not exceed the demand in so large a measure as in the case of naphthalene, so that adaptations of phenol hydrogenation possess relatively little interest, outside of Germany. The successful venture of the Tetralin G. m. b. H. in the field of naphthalene hydrogenation, however, possesses an interest spreading far beyond the confines of a country isolated in war and post-war times.

The Dye Products & Chemical Co., Inc., 200 Fifth Avenue, New York, will in the future put all their products under the brand name "Dyelene." The company manufactures various dyes and intermediates and will continue to maintain the high standard of quality and dependability under the brand "Dyelene." In addition to a representative line of greens, reds, yellows and browns, the company makes metatoluylene diamine and developers. Additional colors are in preparation.

Limitations of Sawdust As a Chemical Raw Material

Commercial utilization of sawdust is made difficult by the small size of the sawdust particles and by the limited quantities available without transportation. These factors are standing in the way of chemical utilization as well as restricting the mechanical uses.

Wood Alcohol

The manufacture of methyl or wood alcohol from sawdust probably will never be done on a large commercial scale. The minuteness of the wood particles causes considerable trouble in any ordinary destructive distillation process, because the stirring of the charge, which is necessary to heat the sawdust mass, results in a fine charcoal dust which clogs the condenser tubes. Then, too, the charcoal by-product, usually a considerable source of revenue in destructive distillation, is not very salable in its powdered condition. A combination of distillation and the manufacture of producer gas from sawdust avoids mechanical difficulties, and charcoal is not one of the by-products. This process might be quite successful if there were a demand for power in a locality where there is an abundance of hardwood waste. The greatest trouble with any sawdust-distillation process, however, is that hardwood sawdust is not obtainable in quantities large enough to run a commercial plant without much expensive transportation, and the process, therefore, must be economical enough to permit purchasing and grinding up large pieces of wood to use along with the sawdust.

Grain Alcohol

Ethyl or grain alcohol can be produced commercially from sawdust. As yet, however, the process is practical only where there is a very large daily supply (at least 250 tons) of wood waste available. Sawdust is well adapted to the production of oxalic acid, but as the yield is large and the demand for the product small, no great volume of sawdust will ever be required for this purpose. Sawdust will probably never be used for paper pulp, for not only does it introduce difficulties in the cooking process, but it also limits the length of the fibers and produces an extremely poor grade of paper.

Cattle Food

A chemical process for converting sawdust of the softwoods into a carbohydrate food for dairy cattle is now being developed at the Forest Products Laboratory. If this experiment is successful, and preliminary manufacturing and feeding tests indicate that it will be, much of the waste sawdust in the softwood regions eventually may be turned into stock food with profit.

Miscellaneous Uses

Because of its insulating, absorbent and resilient properties, sawdust has several mechanical uses. Among these are heat and sound insulation in walls, floor-sweeping compounds, packing for fragile articles, composition flooring and wood flour. Although the mechanical uses are numerous, they are chiefly local, owing to the bulkiness of the raw material; and all together they account for a very small part of the sawdust produced. One of the easiest and in many cases one of the most profitable uses of sawdust at present is for fuel at the sawmill or wood-working plant. Although a specially constructed fire box is necessary to burn such finely divided material, the additional outlay is often a great economy, for it releases for sale larger pieces of wood waste which are more marketable than sawdust for domestic fuel or other uses.

II. Some Economic Aspects of the Practice of Chemistry

OTTO EISENSCHIML deserves credit for his temerity to discuss, with an engaging bluntness notable for its rarity in public consideration of the material problems of chemists, "Some Economic Aspects of the Practice of Chemistry," in March Chemical Age, p. 139.

We emphasize this fact, for the atmosphere of American chemistry has been repressive of open consideration, by chemists themselves, of the conditions of existence that surround the place and the work in industry of the rank and file of chemists. We take to ourselves a measure of the credit which we generously extend to Mr. Eisenschiml in the encouragement of the frank discussion of the chemists' intimate problems. We are gratified to note that, with the chemists' convictions aroused to expression, the desire to discipline the courageous is less in evidence. On the contrary, there is disclosed, with a circumspection natural to the desire to preserve the conditions of control, a disposition to get in step with progressive thought.

Glorification of the Chemist

Let us consider *in seriatim* the development of Mr. Eisenschiml's thesis in the article referred to. He states that the worst time to correct an evil is when it is most rampant, which dictum not only gives human experience a powerful jolt, but compels a scrutiny of the soundness of his doctrine which otherwise might be overlooked.

The glorification of chemists is the work almost entirely of the teachers of chemistry and of the few whose livelihood is concerned with advertising the chemist, in the prospect that popular appreciation of his place in industry will strengthen his economic status. We should not deny to men, wherever they may be lodged in institutions of chemical education, pride in the products of their instruction or decry the idealistic devotion to their science. The elopement of enthusiasm with good judgment is a human frailty.

Our scientific educational society is committed to the increased production of chemically trained men; we should not criticize a society or a system for doing what it is organized to do, and which we all must recognize is a beneficent service in a Chemical Age. The point that Mr. Eisenschiml overlooks is the character of leadership that reflects not the leaven working in the mass.

So long as these men confine their activities to the promotion of scientific and technical education, they are playing on their own grounds; it is when they preempt the attributes of leadership of which they are not capable and in a field quite in contrast to academic seclusion, that embarrassment and lack of confidence follow. Every society, just as every man, to its own trade, for thereby flow the needed service and efficiency in its performance.

Selling chemistry to chemists is a work of supererogation. It indicates a blurred vision, an abortive interpretation of the psychology of the field. Is it any wonder that the disciples revolt at the intellectual strabismus of the leaders of the faith, that does not fix the fact that love for the science flies out of the window when the cupboard is bare?

Constructive Remedies for Present Conditions

The service of the technical professions primarily is to industry and hence they do not lend themselves to the same type of control that experience has shown to be good in those kinds of professional work that deal directly with the people. It is generally accepted that licensing chemists, i.e., eliminating the incompetent by examination, affords no practicable solution of the problem of more men than jobs. Nevertheless, much helpful analogy is found for the economic organization of chemists in the structure and administration of professional bodies that serve society directly.

Mr. Eisenschiml's belief that improvement in the economic status of the chemist can come only either from decreasing the supply or increasing the demand, shows a grasp of economic law and the futility of artifice that contradicts it to improve the conditions complained of. With every indication of increasing numbers of chemically trained men, for which we do not have to look farther than the growing facilities in every state for their production, consequent upon the importance placed by industry upon the possession of chemical knowledge, constructive suggestions, as is emphasized, must be in the direction of increased demand.

The fortunes of technical professional men, depending as they do upon the fortunes of the enterprise of organized industry, rise and fall with industrial activity, and so impart to the class a mobility shared to the same degree by none of the conventional professions. Insofar as individuals of the class are concerned, this has, from the standpoint of acquiring experience, its advantages and disadvantages, the latter far outweighing the former and subjecting the technical practitioner to the ever-impending fear of unemployment, and the competition of younger men.

We cannot escape the fact that the production facilities of institutions of professional chemical training are far in advance of the needs of chemical industry. When ambitious youth has acquired the qualifications for initial work as a chemist, only persistent discouragement will compel him to sacrifice his hard-won academic attainments in a job in which they serve him little. The whole situation, even with the eventual resumption of general business activity, holds out little promise of any improvement in the morale of the profession of industrial chemistry, under the existing system of the production and segregation of educated chemical workers.

Solidarity of Interest

Mr. Eisenschiml cites an example illustrative not only of the hodge-podge mixture of interests in the existing system of segregation, but of the unrepresentative character of chemical leadership. At this season he could not help but be reminded of the equestrian in the circus who rides three horses at once—an exploit certainly rich in the spectacular but of little utility. Of the quotation from the official editorial in our Society Journal, viz., *"Fortunately the interests of our individual members, our Society and the industry are identical,"* he says. *"Such sentiment will have to disappear if we are to accomplish anything at all. If we (chemists) want to get results we first must develop some sort of class consciousness."*

Here Mr. Eisenschiml hits upon the prime deficiency of American chemists, viz., the lack of class consciousness, and sees little hope of its cultivation in an organization that not only seeks to ride several horses at once, but futilely to arrogate to itself dominion over the whole show.

American Institute of Chemistry

Here Mr. Eisenschiml brings us face to face with the question: Shall the economic organization of American chemists be created within the American Chemical Society, or be a separately constituted organization, but complementing it in its service to American Chemistry? He feels that the functions of the economic organization can be worked within the Society, that the lion and the lamb *et al* can lie down together. We doubt if Mr. Eisenschiml really thinks so. It seems that from his point of view the interests favored by a buyers' market for chemical service, perhaps, can be eliminated from the control of a scientific society, with resultant advantage to those who have the service to sell, all of which is impracticable and vain to attempt, in view of the importance of the society's work in the progress of the science and art of chemistry.

He pleads for the cultivation of class consciousness as a condition precedent to the improvement of the economic status of the chemist. We agree with him as to the impracticability of this in our Society, and quote from CHEMICAL AGE, Aug., 1921, wherein we discussed the conditions attending the organization of the Institute of Chemistry of Great Britain.

> "In the discussion of the subject at the time, as reported in the *Chemical News*, it was disclosed that the roll of the Chemical Society included amateurs and students who were not teaching or practicing the science and art of chemistry, and that not a few sought membership to support claims to scientific attainments in the estimation of the public. An element of the membership of the Chemical Society who desired to maintain the prestige of the society as a representative organization of chemists refused to vote for the election of any member who could not show evidence of scientific attainments to the end that the initials 'F.C.S.' (Fellow of the Chemical Society) might become an indication of professional qualifications and the Chemical Society the guardian of the professional interests of chemists.
>
> "The conclusion was expressed at the time that the public regarded membership in the Chemical Society as the recognition of knowledge and skill in the science of chemistry, but that as a matter of fact the roll of the society embraced the amateurs of every grade with motives of affiliation often far without the purview of the society, and the workers, no distinction as to which being made.
>
> "It was admitted that the Chemical Society was not founded to separate the sheep from the goats but for the general advancement of chemical science and that membership growth was vital to the progress of the society because of its need for funds to meet the cost of its publications.
>
> "That the Chemical Society had performed all other functions [illegible] neglect or refusal to cultivate the professional interests of those members qualified to call themselves chemists; that if such steps might conduce to the general advancement of chemical science, the society by [illegible] the purpose for which it was founded but by opposition to the plan exposed itself to the charge of retarding the progress of chemistry."

APHORISMS OF EISENSCHIML

A LABORATORY chemist is generally paid merely for collecting facts and can expect no high pay for this service. The man that assembles these data and draws the business conclusions is the one who reaps the harvest.

* * *

Our colleges dismiss their graduates with the impression that their earning power will be in direct ratio to knowledge and chemical ability. That is not so. Chemical knowledge must be sold, and in order to bring handsome returns must be sold cleverly.

* * *

A man may sacrifice his life on the altar of science, but he has no right to sacrifice his wife and children likewise.

* * *

I do not blame the colleges for not giving courses in salesmanship of chemical knowledge. I do blame them for failing to point out to their students that such salesmanship is essential to their progress.

* * *

Most chemists hold good hands and play them like amateurs. Most business men hold nothing but a small pair and take the pot.

* * *

I often wonder if our colleges, training men for chemistry without regard to their future, are aware of the heavy moral responsibility that rests on their shoulders.

* * *

I have been criticized and ridiculed for discussing the possibility of reducing the number of chemists by disseminating facts among students regarding the true earning power of our profession. Is it more desirable to have men of forty quit in disgust and despair than to give the prospective chemist an inside tip on the material rewards of his chosen career?

* * *

Business after all is nothing but applied common sense. [illegible] both applied common sense and applied chemistry.

We also direct the reader to the article by Harold J. Roast, secretary, Canadian Institute of Chemistry, in CHEMICAL AGE, January, 1922, wherein he quotes from the report of the organization committee, as regards the formation of the economic organization of Canadian chemists, as follows:

> "The organization of Canadian chemists is best undertaken by an entirely new and separate organization rather than by endeavoring to carry out such organization under the auspices of any existing society."

An interesting aspect of the history of the Institute of Chemistry of Great Britain, of which Dr. Alfred Chaston Chapman, its present president, stated, as reported in March CHEMICAL AGE, that only 2 per cent. of its 3,500 members were unemployed in a period of unparalleled industrial depression, is the confession of mistaken judgment on the part of prominent English chemists who had opposed its organization. Prof. Raphael Meldola, early strongly antagonistic to the professional economic organization of English chemists, eventually was honored by election to its presidency.

> "Prof. Meldola in his first presidential address, on March 3, 1913, stated that he welcomed an opportunity of making confession of a change of view concerning the functions of the Institute. He happened to be a survivor from the period when the agitation in the chemical profession resulted in the organization of the Institute. At that time, in common with many of his contemporaries, he regarded the new movement, if not with actual disfavor certainly with indifference.
>
> "It was held by many that there would be no scope for such a body, and that no justification could be found for the creation of another corporation of chemists. It was with especial pleasure, therefore, that he was able to make amends for that error of judgment and to declare that the more he had seen of the work of the Institute the more strongly had he become convinced that it had a public mission to fulfil of precisely the same order of importance as that discharged by other bodies of professional men who served the community in various capacities.
>
> * * * "The consolidation and the elevation of the profession lay in their own hands, and the status which the chemical practitioner should occupy in the public estimation was bound to become more and more determined in the future by the standards of efficiency and of conduct set up by the Fellows and Associates." *

Quoting further from the same article:

> "Comparison of present conditions in America with those prevailing in England fifty years ago as regards the status of education in applied science and in chemistry particularly, indicates that the forces impelling economic organization of chemically trained men are not entirely the same in each era.
>
> "In the former era the relatively primitive status of chemical [illegible] the inferior state of scientific education and the incompetency among the practitioners of chemistry, disclosed especially by the legislative imposition of responsibilities, made necessary the establishment of an organization to standardize [illegible]

---

*Chemical Age, August, 1921.

educational methods, to inculcate professional standards, to promulgate qualifications to eliminate charlantry and to enforce public confidence in and respect for the professional status of the chemist.

"Antagonism on the part of the Chemical Society to such an organization, to say nothing of the attitude of the Pharmaceutical Society of Great Britain in refusal to recognize any other class of chemist but the apothecary and in resort to law to deny to the new organization the use of the term "chemist" in its corporate name, indicate in the latter a condition practically non-existent in America and in the former a perennial state of conservatism, an intolerance that makes a fetich of organization, whose exponents magnify the machine and deprecate, regardless of the performance of an essential service, any progressive movement not originating with the element in control.

"The pedagogical and technical conditions in England that fifty years ago demanded correction and found it in the initiative of a new economic organization, do not exist today in America, but the mental attitude toward disturbing innovations has the pertinacity characteristic of an attribute of human nature."

Certainly a new organization is not necessary to arouse chemists into action. They are aroused already. A new organization is necessary to perform functions incompatible with the educational service of a scientific society, membership in which means nothing as regards improvement in the chemists' material welfare.

We contend that the American Chemical Society should be supported in its educational activities; that to engraft upon it such functions as are within the purview of a professional organization, not only will distract it from its primary obligations to American chemistry, but expose it to the influence of a spirit inimical to its program.

Summary

Mr. Eisenschiml submits two plans for improving the economic status of the chemist, which he considers feasible. The first is the regulation of the number of chemical students by publicity. How can this method be reconciled with the position of the American Chemical Society in the encouragement of chemical education and with the investment of millions, by men hailed as public benefactors, in increased facilities for providing it? The second plan is to open up new avenues of employment for chemical graduates. Under the conditions stated as contradictory to Mr. Eisenschmil's first "feasible" plan, the chemical graduate, as a class, in his non-chemical employment has a perspective in which appears much misdirected academic activity.

In substance, Mr. Eisenschiml relegates the whole matter to the law of supply and demand, and so in fact, presents not a single constructive suggestion in way of ameliorating the waste incident to its operation. This sterility of thought on a subject of vital interest to thousands of our kind is notable especially at a time when the brightest minds in every field of enterprise in America are concerned with the elimination of waste.

Waste elimination, inanimate and human, is the measure of progress. We need only refer you to Dr. Scott's article on "Progress in Human Engineering" on page 151, to enforce the fact that the great problem in industry in our generation is increased efficiency in handling its human raw material. How vastly important it is that the educated element of this raw material, from which leadership primarily will be recruited, should be made the subject of organized consideration that it may develop with the maximum efficiency, that is with the least waste, which means the maximum advantage to the individual and the greatest profit to industry.

The only answer is a professional economic society which will mean something to the member, not necessarily as an educative factor solely in his career, but as a mechanism designed to make the most out of chemically trained men, and to give form and substance to a field now structureless in its disorder.

Investigation of Georgia Clays by Bureau of Mines

The kaolins and bauxites of Georgia occur principally in the Coastal Plain, the belt running diagonally across the State from East to West. The railroad lines of the Central of Georgia reach about 80 per cent. of the white clays and bauxites of this region. The white clays are being mined at a few points, principally at Gordon, Claymont, McIntyre and Butler. These clays are sold principally to the filler trade. Bauxite mining has been carried on in the Cuthbert, Toomsboro and Andersonville districts and the bauxite is used principally in the manufacture of alum, abrasives and aluminum. The value of the clays and bauxites for ceramic purposes is little known.

English china clay is preferred to Georgia kaolin by many American potters. In comparing the two it is found that the Englsh clay disintegrates in water more readily, produces a body which casts more satisfactorily, gives lower drying and bisque losses and requires less linseed oil to produce a spreading condition for oilcloth and produces a paper of better finish and more resistant to moisture. In preliminary work by the Bureau of Mines it was found that after calcining Georgia kaolin to low temperatures (500°-600°C) it possesses properties similar to the English china clay, i.e., its absorptive properties are decreased to that of the English china clay and the rate of capillary flow and the permeability of water is increased. Further tests are to be made to determine its commercial feasibility. The effects of ageing the calcined clay in air and water are to be studied to determine how far the calcined clay will revert to its original state and also to study the varieties produced by different calcination tempers.

The investigation undertaken by the Ceramic Station of the Bureau of Mines, Columbus, Ohio, in co-operation with the Central of Georgia railroad, will consist in experiments to devise better refining methods and to test the physical properties of the different separations obtained. For this purpose a small size refining plant is being constructed at the Ceramic Station.

This equipment is capable of handling from 500 to 1,000 lbs. at a time. Evidently some of the clays will show promise of being valuable for pottery making purposes. After the laboratory tests are completed by the Bureau of Mines about 400 lbs. of such clays will be taken into a commercial pottery and made up into pottery wares under practical working conditions, and the behavior of such clays as to working properties, color, percentage losses, etc., will be carefully studied.

The white clays and bauxites of the coastal plain are closely associated and this close association indicates that the bauxites were derived from the alteration of kaolins. Deposits are found which vary all the way from kaolin on the one hand to bauxite on the other. Some of these materials, which are higher in alumina than kaolin, show better refractory properties than No. 1 fire clays. Such clays, termed "Bauxitic Clays," undoubtedly would be most valuable for the manufacture of refractories superior to those now being made from fire clays. The refractory properties of such materials are to be studied, such as fusion temperature, load carrying capacity, resistance to spalling. Chemical analyses of the Georgia materials are to be made since it is important to know the different components making up the clays and bauxites.

Preparation of Vitamine-Activated Fuller's Earth

By Atherton Seidell

Technical Assistant, United States Public Health Service

SINCE the discovery several years ago[1] that certain varieties of fuller's earth, particularly the variety from Surrey, England, exert a remarkable adsorptive power for the antineuritic vitamine, this reagent has been exclusively used as the first step in my attempts to isolate the vitamine from brewer's yeast. For this purpose the fresh yeast was allowed to autolyze, and the resulting product was filtered. Fuller's earth was then added to the clear liquid and, after thorough agitation, the solid was removed by filtration and was washed and dried. The "activated fuller's earth" thus prepared, on account of its relative uniformity and exceptional stability, was believed to be the most favorable raw material for experiments on the isolation of the antineuritic vitamine.[2]

The most unsatisfactory step in the process of preparing "activated solid" is the extremely slow and wasteful filtration of the autolyzed yeast. Numerous experiments were early made for the purpose of eliminating this very troublesome filtration, but improvements worthy of recommendation were not developed. Recently, however, by making use of an observation of Osborne and Wakeman,[3] a substantial improvement in the method has been made and is now brought to the attention of persons interested in the more precise study of the chemical and physiological properties of the antineuritic vitamine.

It was demonstrated by Osborne and Wakeman that when fresh yeast is added to boiling water, acidified with 0.01 per cent acetic acid, the yeast cells are disrupted, the protein is coagulated, and the vitamine is set free to enter the aqueous solution. This latter can readily be separated from the coagulated protein and insoluble material and is a very much more satisfactory solution for the adsorption of vitamine by fuller's earth than the very complex filtrate from autolyzed yeast.

The advantages resulting from this modification are that the manipulations are greatly shortened and simplified and, what is of greater importance, a much better final product is obtained. The basis of the latter claim is that at least one of the interfering substances simultaneously adsorbed with the vitamine is almost, if not entirely, eliminated. This compound is adenine, which is a product of the autolysis and is present in the yeast filtrate and subsequently adsorbed by the fuller's earth. It is, however, not formed to an appreciable extent during the rapid heating of the fresh yeast according to the modified method, and consequently does not become an impurity in the final "activated solid."

Preparation of "Activated Solid"

The improved method for preparing vitamine-activated fuller's earth on a moderately large scale has been very satisfactorily carried out as follows:

Fresh bottom yeast, as obtained from the brewery, in quantities of 50 or more liters, is diluted with about an equal volume of tap water and heated, while being stirred, in a steam-jacketed kettle until the temperature reaches approximately 90° C. It has been found that if this temperature is exceeded, the mixture is apt to foam excessively and overflow the kettle. After about 5 minutes at 90°, the mixture is cooled to 50° or less, and the coagulated protein is removed by filtration.

The protein can be very effectively and expeditiously removed by means of a large Sharples centrifuge. The protein remaining in the bowl of this machine is of cheese-like consistency and retains a relatively small proportion of the aqueous vitamine solution. This latter is a clear dark-brown liquid. English fuller's earth is added to it in the proportion of 30 grams per liter and the mixture is actively stirred for one-half hour or longer. It is then subjected to filtration or the solid may be removed more conveniently by means of the Sharples centrifuge. The "activated solid" is finally washed with several changes of water and alcohol and then thoroughly dried to prevent subsequent growth of molds, which are very readily nourished by the minute amounts of organic material from the yeast solution, persistently retained by the "activated solid."

Samples of "activated solid" prepared by the above process were found to contain approximately 1.5 per cent of nitrogen instead of slightly more than the 2 per cent usually present in samples prepared by the original method from autolyzed yeast filtrate. The content of antineuritic vitamine, as estimated by feeding experiments on pigeons, was found to be about twice as great as that of the product made by the original method. Complete protection of pigeons against loss in weight on a diet of polished rice, or restoration of such lost weight, was afforded in all cases by doses of 0.1 gram on alternate days. Doses of 0.05 gram prevented all but a very slight diminution in weight for many weeks.

From these tests it is evident that the protective dose for pigeons of 300 grams weight is under 0.1 gram; whereas with samples of "activated solid," prepared by the original method, adequate protection usually required doses between 0.1 and 0.2 gram. This, taken in connection with the lower nitrogen content and absence of adenine is ample evidence of the greatly improved character of the "activated solid" prepared by the new method.

New Jersey Chemical Society

One of the most largely attended meetings of the New Jersey Chemical Society was held on April 11, at Stetter's restaurant, Newark, on the occasion of the annual election of officers. The present administration by acclamation was continued for the ensuing year. William Haynes' effort to commit the society to the adoption of resolutions favoring American valuation precipitated some argument which resulted in the matter being referred to the consideration of the board of governors. Prof. W. D. Harkins, University of Chicago, conducted the audience into the theoretical mazes of physical chemistry in a discussion of the building of atoms. C. L. Bryden, chairman of the committee on chemical industry, in co-operation with E. J. Jarvis, McNab & Harlin Mfg. Co., Paterson, N. J., has arranged for an inspection of the McNab-Harlin plant at Paterson on Saturday, May 6, together with a visit to the local water works and power plant at Passaic Falls, and to other plants if time permits. Dinner will be served at the Chamber of Commerce where J. J. Fitzgerald, secretary of the Chamber, will address the visitors on "Paterson and its Industries."

---

[1] [illegible] Public Health Reports, 31, 364 (1916).

[2] [illegible] 1922.

[3] Osborne and Wakeman, J. Biol. Chem., 40, 383 (1919).

Fire Hazards in Chemical Plants

A Study of Fire Losses in Chemical Plants by the National Fire Protection Association, With the Circumstances of Some Typical Fires.

IT is not surprising that a classification of chemical plant fires indicates that about 71 per cent. of the total known causes of fire are due to hazards incident to the industry. It is difficult to devise an adequate classification of these special hazard fires because in many instances the rapidity of spread of the fire has prevented ascertainment of the exact cause. Accordingly many of these fires have necessarily been attributed to the rather indefinite items of "Ignition of Chemical," "Ignition of Inflammable Vapor," etc.

In so far as possible the exact cause or the process responsible has been given. While some of these fires are perhaps unpreventable it seems probable that the majority of them were due to carelessness. The common hazard fires are fairly generally distributed, heating being the main cause. Many of these fires could probably be indirectly traced to the inflammable nature of the materials stored and in process.

The sprinkler record is very satisfactory considering the large number of severe fires in this class. Only 5½ per cent of sprinkler fires were failures. A comparison of wet and dry systems indicates that the systems were about equally efficient. The average number of sprinkler heads opening is 23, an unusually high figure. This is another indication of the severity of fires in this occupancy.

Slightly more fires occurred in the daytime than at night. In chemical plants the hazard would naturally be greater during operation of the plant. About 40 per cent. of the fires involved losses of over $1,000. It is worthy of mention that 80 per cent. of the fires causing loss of over $1,000 were in unsprinklered properties. Fifty-seven per cent. were due to hazards incident to the industry.

In the following descriptions of typical fires are related circumstances that should not fail to have admonitory value to all plant executives responsible for the conduct of process work:

Ignition of Alcohol Vapor

At the time of the fire an iron still, 200 gallons capacity, was being used to recover alcohol by distillation. A gas light was located at the still for reading a thermometer. It is believed that the distilling process became deranged in some way, permitting the escape of a large quantity of hot alcohol which became ignited from the open gas flames in the room.

Exactly what happened is not known as the chemist, who was the only person in the room, was killed by the ensuing explosion. The fire and explosion severely damaged the building. Another man was killed by a falling beam. The fire was extinguished with considerable difficulty owing to the large quantity of alcohol involved.

Explosion of Apparatus

The plant was engaged in making phosphoric acid in an electric furnace. At the time of the explosion the furnace was in full operation, containing a charge of phosphate rock, coke, and sand, and was heated to a temperature of approximately 1,700° C. One of the nozzle plugs that permits molten slag to discharge from furnace to cooling pit blew out, and immediately the molten contents discharged into the cooling pit. Some water was in the pit and the rapid generation of steam caused by the molten slag falling in the water caused an explosion that scattered slag at high velocity throughout the building.

A fire was caused by some of the slag being forced against 2,300 volt, 3-phase wires and exposed single pole knife switches in a nearby transformer room. A short circuit immediately occurred, which heated the wires to incandescence and ignited the woodwork of roof and walls. The fire was extinguished by employees, much of the equipment being damaged by water.

CLASSIFICATION OF CAUSES OF FIRE IN CHEMICAL PLANTS

Total Number of Fires Reported 473

Special Hazard Causes

	No. of Fires	Per Cent. of Special Causes	Per Cent. of Known Causes
Ignition of chemical	38	13.6	9.8
Explosion of chemical	33	11.9	8.4
Overflow or boiling over of chemical	31	11.2	7.9
Spontaneous ignition of chemical	30	10.8	7.7
Foreign substance in grinding mill	24	8.6	6.1
Ignition of inflammable vapor	20	7.2	5.1
Drying room	16	5.8	4.1
Explosion of apparatus	16	5.8	4.1
Overheating of kettle or oven	14	5.0	3.6
Sparks ignite chemical	13	4.7	3.3
Spilling of acid or ether	8	2.9	2.0
Ignition of oil	7	2.5	1.8
Ignition of gas	5	1.8	1.3
Ventilating fan	4	1.4	1.0
Miscellaneous special hazard causes	19	6.8	4.9
Total	278	100.0	100

Common Causes

	No. of Fires	Per Cent. of Common Causes	Per Cent. of Known Causes
Heating	22	19.4	5.6
Matches—Smoking	16	14.2	4.1
Power	14	12.4	3.6
Lighting	13	11.5	3.3
Spontaneous Ignition	12	10.6	3.1
Sparks from Locomotive	8	7.1	2.0
Exposure	7	6.2	1.8
Defective Electric Wiring	6	5.3	1.5
Incendiary	5	4.4	1.3
Defective Flues	4	3.5	1.0
Lightning	3	2.7	.8
Miscellaneous Common Causes	3	2.7	.8
Total	113	100	

SUMMARY		Per Cent.
Common Causes	113	24.0
Special Hazard Causes	278	58.8
Total Known Causes	391	82.8
Unknown causes	82	17.2
Total	473	100.0

Overflow of Chemical

I. In this plant nitric acid was manufactured by heating sodium nitrate, in stills, with sulphuric acid. The sodium nitrate was usually brought to the stills in a conveyor but this had broken down and it was necessary to take the nitre in bags and empty it into the stills by hand. The bags were then thrown to one side and afterward removed.

It so happened on the morning of the fire that a small number of these bags had been thrown to one side, a short distance in front of the furnaces. One of the men was drawing the hot liquid (acid sulphate of soda) from a small opening near the bottom of one of the stills when in some unknown manner it overflowed, coming in contact with the pile of bags. These instantly blazed up, making a hot fire and igniting the board wall of the building. The building and contents were practically destroyed.

II. The contents of caustic fusion tanks, used in preparing synthetic phenol, was being drawn off by means of open metal troughs to acidification tanks nearby. Apparently a little splashed over sides of trough and on account of its high temperature (500° F.) it ignited fuel oil which had dripped on the floor from the fuel oil burners that heat the tanks. This blazed up and set fire to the light wood platforms around the tanks. The bases of these platforms were oil soaked and burned rapidly. The fire spread and destroyed the building which was of light frame construction.

Ignition of Chemical

This fire was the direct result of carelessness of an employee. The plant was manufacturing chlor-benzol. The workman started to fill the benzol storage tank from a tank car. It is said he was under orders to leave the car west of the extreme end of the potash building and connect up pipe to it from tank. Instead of doing this, he moved the car up to a point nearly opposite the chlor-benzol plant and directly opposite the potash furnaces, which were in operation only fifteen feet away. In some way the benzol became ignited.

The outlet of the tank car consisted of an inside valve, protected by metal plate. It is considered probable that this valve was open, and when the coverplate was taken off to attach the pipe line, the benzol leaked out, falling into the coal pit, and almost instantly reaching the potash furnaces and being ignited. The workman was seriously burned and was rescued with great difficulty. The chlor-benzol plant was practically destroyed. The interior of the potash building was not damaged, although two of the brick panel walls were so badly spalled that they had to be rebuilt.

Sparks Ignite Chemical

Fire occurred in a picric acid plant in the acid washing building. Picric acid is washed with water and the water is then extracted by centrifugals. These are driven at high speed by belts and it is believed that when one was stopped, the friction of the belt caused a spark which ignited the acid. Three workmen at hand ran instead of attempting to extinguish the incipient fire. As a consequence the fire spread rapidly and five buildings were badly damaged.

Explosion of Chemical

The plant where the explosion occurred manufactures dye intermediates and reduces the nitro derivatives to obtain toluidines. The process consists of nitrating toluol and then running the resulting mononitrotoluol by gravity by enclosed iron pipe to another building where it is reduced and distilled, the distillation being done in a vacuum still heated by an open flame kerosene oil burner. The needle valve in the gauge on the still stuck and the foreman opened the gauge in an attempt to release the needle valve without shutting off the fire.

Usually when the gauge is open none of the contents of the still escapes on account of it being under vacuum. Presumably there was a leakage and some of the contents of the still escaped, getting on the clothes of the foreman. The fumes, coming in contact with the open flame, set him afire. He then ran from the building calling for help and leaving the gauge open. More of the liquid escaped, filling the building with an explosive mixture of fumes and an explosion occurred which threw down the upper walls of the building, a fire-resistive structure.

Foreign Substance in Grinding Mill

Fire occurred in the grinding room of a plant manufacturing coal tar dyestuffs. The grinders consisted of a number of circular discs revolving at high speed. The material to be ground is thrown against a wide steel ring inside of which the discs revolve. The ground color is discharged from the mill with considerable velocity into horizontal steel-cased mixers. A vent to relieve air pressure is provided in the form of a cloth balloon with a return pipe to the grinder.

An iron bolt accidentally got into the grinder and when a spark was struck, fire instantly flashed through to the mixer and out again to the balloon where a mild explosion took place. The flame flashed through the room and to the floor above. Sprinklers did good work in extinguishing the fire although several barrels of color burned for some time. The loss was small considering the severity of fire.

Smoking

Fire occurred in a section of the plant used for making saccharin. In the process, toluol is brought into the room in steel drums and siphoned into small glass bottles to carry to mixing tanks. Two men were working in the room. A spark from a cigarette ignited the toluol. A flash fire followed and one man was killed and the other badly burned.

The fire quickly ignited the contents of a toluol drum and the head blew out, spreading the burning fluid. All the sprinklers operated but could not extinguish the flames, water having but little effect on the burning toluol. The building was of reinforced concrete and was not badly damaged.

Manufacturers of food products in New Jersey have taken initial steps to organize a state association, to be called the Food Product Institute of New Jersey, with the following aims, as expressed by Samuel Mueller, president C. F. Mueller Co., Jersey City, at a meeting at Newark, March 24: 1. To better conditions and promote the welfare of the food producing industries of the state; 2. To make possible a practical and scientific study of food values; 3. To limit membership to such firms as can qualify by meeting the standards set by the society; 4. To promote research in the food industry by providing a laboratory for this purpose; 5. To promote the consumption of Jersey-made products within the State. Many of the leading concerns in food products manufacture in New Jersey are interested. All engaged in this line, are requested to express their intention to attend the second organization meeting to Dr. Frederic Dannerth, 96 Academy Street, Newark, N. J., temporary secretary of the Institute.

Isinglass

Its Sources, Manufacture, Composition, Properties, Adulteration and Uses

By Robert Herman Bogue

Industrial Fellow, Mellon Institute of Industrial Research of the University of Pittsburgh; Research Chemist, Armour & Co., Chicago

TWO very different types of glue are made from parts of the fish. The very highest grades of gelatin may be prepared from the swimming bladders. This product is more nearly water-white than any animal gelatin, but it is difficult entirely to remove from it a fishy odor that makes it less desirable for culinary purposes than the animal product. The uncooked sounds are sold as *isinglass,* but after these have been dissolved in water and converted into gelatin it is better known as *fish gelatin, isinglass gelatin,* or *refined isinglass*. On account of its greater cost it has not been able to compete as an ordinary adhesive with animal glue.

A less desirable product is produced from the skin, scales, heads and other refuse of fish. These parts may contain much material of a non-protein nature, and often are contaminated with salts, blood, flesh, etc. It is very difficult if not impossible with the use of skin stock, even though selected and treated with great care, to obtain a product of sufficiently high gelatin content to set to a firm jelly at ordinary temperatures. For this reason the material is commonly sold in liquid form as rather thick viscous fluids. A firmer jelly may be produced from the fish head stock. The natural odor is always strong and offensive, and to mask it and make it less objectionable some aromatic substance of a strong odor as creosote, oil of sassafras or wintergreen is added.

It should be pointed out that all liquid glues are not fish products, but that animal glues are sometimes treated with a chemical which destroys the power of the glue to form a jelly. Acetic acid and nitric acid are used for this purpose. It is doubtful if this practice is profitable; for although a glue is obtained that may be used without warming or other preparation, yet the strength per unit concentration of dry glue is diminished, and the joint is apt to decrease in strength with age. The diminished strength is usually compensated by increasing the concentration at which it is applied, but this hardly can be regarded as an economic procedure. For small repair work and household use it is, however, convenient. The use of calcium or magnesium salicylate and of thiourea recently have been proposed for the preparation of a liquid glue.[1]

Sources of Isinglass

Isinglass (from the Dutch *huisenblas,* German *hausenblause,* meaning sturgeon's bladder) is as its name signifies, a product composed of the air or swimming bladders of certain of the fishes. Most important of these is the sturgeon, and for centuries the material has been obtained and exported from Russia. In many of the fishes this bladder is too small or too securely fastened to the backbone or abdominal wall to make its removal a practicable proposition, but the sturgeon, the catfish and the carp long have been utilized for this purpose.

More recently many other of the fishes have been used for the manufacture of isinglass. The *Siluridae* are used in Brazil and Venezuela. Iceland exports a good quality made from cod sounds; the cod also is used to some extent in Norway and in Canada for this purpose. The North American product is obtained chiefly, however, from the large hake that are obtained in deep water. Over 100 tons of hake sounds were obtained annually on the New England coast alone a few years ago, but the production is much less at present. The squeteague has also been much used, and the tile fish has been demonstrated to be well adapted to the production of isinglass.[2] The yield and quality of the product varies greatly with the specie of fish. The large deep-water hake yield from 40 to 50 lbs. of dry isinglass per ton of fish, and the product contains about 85 per cent. of gelatin. The smaller shallow-water hake yield only about 30 lbs. of isinglass per ton of fish. The cod yields but 15-20 lbs., and the squeteague 20 lbs. The gelatin content of the product from the latter two species is also low, being only about 50 per cent.

Manufacture of Isinglass

Isinglass appears on the market in several different forms. The best Russian product is known as "staple" isinglass and may be obtained as long or as short staple. It is made by rolling each bladder and folding around a few pegs set in the form of a horseshoe. The leaves are sometimes twisted like ropes. When the bladders are merely placed one upon the other in sheets it is known as "leaf" isinglass. If these leaves are folded before they are completely dry, and covered with a damp cloth they constitute "book" isinglass.

The preparation of the material for the market is very simple. The Russian method is as follows: The sounds are allowed to remain in water for several days with frequent changes of water to remove the blood and fatty matter present. After the washing is complete the sounds are cut longitudinally into sheets. These are laid out to dry by exposure to the sun and air upon boards of linden or bass wood. During this process the inner layer, which is the layer consisting of pure isinglass, is uppermost, and after a partial drying it may be removed from the coarser external lamellae. These finer sheets are placed between cloths to protect them from the flies, and are subjected to heavy pressure to flatten them.

After thoroughly drying they are assorted and tied up into packages for export containing 10 to 15 sheets and weighing about 1¼ pounds. These packages are commonly shipped in lots of eighty sewed up in a cloth bag or inclosed in leadfoil. The external layers are softened with water and a considerable amount of gluey material scraped off which is moulded and dried. This is used as an inferior isinglass. The residue, together with trimmings from the sounds and other parts of the fish, is boiled with water to produce a fish glue.

The preparation of isinglass in this country differs from that outlined above chiefly in the introduction of machinery for the hand labor. The sounds, especially from the hake, are often detached on the fishing vessels when dressing the fish, and are then salted in barrels so that they will not decompose. They are sometimes air dried in that condition. Upon delivery to the isinglass manufacturer they are first soaked for several hours in water to soften them, washed, slit open, and the black outer membrane scraped off, and again thoroughly washed. The pure sounds are then usually run into a cutting machine provided with a roller and a set

---

This article represents a part of the section on "Glues of Marine Origin," in the writer's forthcoming treatise on "The Chemistry and Technology of Gelatin and Glue," to be published by the McGraw-Hill Co., of New York, in the Summer of 1922.

[1] D. K. Tressler, *U. S. Pats.* 1,394,653 and 1,394,654. October 25, 1921.

[2] G. F. White, [illegible] Doc. 852 (1917), 7.

of knives in which they are chopped into small pieces.

This material is mixed and macerated between rollers, and then passes to the sheeting rollers. These are hollow iron rollers in which cold water is allowed to circulate to prevent a softening and sticking of the sounds. A thick sheet is formed which passes in turn to the ribbon rollers where it is drawn out into a thin uniform ribbon a sixty-fourth of an inch in thickness and six to eight inches in width. The ribbons are suspended in warm rooms where they dry out in a few hours, and are then rolled on wooden spools into coils weighing less than a pound each. The recovery of isinglass by this method is about 80 per cent. of the weight of the original sounds.

A product obtained by dissolving New England isinglass in water, straining off the insoluble material, and spreading in very thin sheets on oil cloth or glass, is known in the trade as transparent or refined isinglass.

Composition

The composition of isinglass from various sources has been reported by Prollius,[1] and is given in the following table:

Composition of Isinglass

	Ash *per cent.*	Water *per cent.*	Residue insol. in hot water *per cent.*
Astrakhan (Russian)	0.20	16.0	2.8
Astrakhan (Russian)	0.37	18.0	0.7
Astrakhan (Russian)	0.20	17.0	1.0
Astrakhan (Russian)	0.80	19.0	3.0
Astrakhan (Russian)	0.50	19.0	0.4
Astrakhan (Russian)	0.40	17.0	1.3
Hamburg	1.30	19.0	2.3
Hamburg	0.13	19.0	5.2
Iceland	0.60	17.0	21.6
East India	0.78	18.0	8.6
Yellow, unknown source.....	2.30	17.0	15.6

The high reputation which the Russian product enjoys is shown by the above table to be quite justified. The insoluble matter and ash are low, and the analyses run reasonably uniform. A certain amount of matter insoluble in hot water will always be found, but in the best grades it is low.

Properties

On soaking in cold water isinglass swells uniformly but slowly, and does not take up nearly the amount of water that will be absorbed by a similar weight of gelatin. The isinglass, it must be remembered, is not gelatin but rather collagen, and in order to convert it into gelatin a brief heating in water is necessary. When it is made and allowed to dry out, the product will then possess all of the characteristics commonly associated with gelatin. Its jelly strength will be fairly high; it will be clear and almost colorless, and produce a glue of high adhesive value. A distinctive fishy odor will always be present unless some material has been added which serves to mask that odor by imparting to it a stronger, although less disagreeable one of another character. In its several tests it responds in a way entirely similar to animal gelatin.

Adulteration

Since isinglass is more expensive than gelatin, attempts have frequently been made to adulterate it. One of these methods is by rolling a layer of gelatin between layers of isinglass. White[1] reports that such adulteration easily may be detected by treating with water and observing the nature of the colloidal solution under the microscope. The isinglass will retain its characteristic fibrous structure which is not present in a gelatin solution, the shreds becoming disintegrated.

In addition to adulteration, imitation is sometimes attempted by putting out material that is intended to simulate the true isinglass, but which is made from altogether different material. Thus blood fibrin, calves' foot gelatin, agar agar, etc., have been manufactured to resemble natural isinglass.

Uses

One of the oldest and best established uses of isinglass is as a clarifying agent for various beverages as wine, cider, and malt liquors. The efficacy of the isinglass for this service lies in the purely mechanical property it possesses of maintaining a fibrous structure in the solution, and as this settles slowly to the bottom it entangles in its netlike meshes the colloidal bodies that produce the undesirable turbidity.

For clarifying wine the isinglass is first swollen in water and then in the wine until it is completely swollen and transparent. It is then thoroughly beaten into a small amount of wine, strained through a linen cloth, and stirred into the rest of the wine. The temperature is kept low and the isinglass does not go into solution, but only into a very finely divided suspension. Thus the original fibrous structure of the sounds has at no time since it came from the fish been lost. In this lies the difference in the action of isinglass and gelatin for fining. If isinglass were heated and made into a true gelatin it would then have lost the properties which make it so valuable for this service. A single ounce of isinglass will clarify, under the optimum conditions, 500 gallons of wine in ten days.

In the manufacture of beer and ale the starch granules, bacteria and protein matter which do not settle in the tanks after the primary fermentation are gotten out by either filtration, adsorption upon wood chips, or fining. In the latter procedure the isinglass is treated with sour beer and, after swelling, macerated as in the fining of wine. After straining it is mixed thoroughly with the rest of the beer. One pound of isinglass will fine from 100 to 500 barrels of beer.

Other uses of isinglass are somewhat scattered. In court plaster isinglass is frequently used instead of gelatin, the proportions being about 10 grams of isinglass, 40 grams of alcohol, 1 gram of glycerin, and water to make a total weight of 120 grams. Taffeta is first treated with successive layers of isinglass in water, then with the isinglass, water, alcohol and glycerin solution, and the reverse side covered with tincture of benzoin. This is said to be sufficient for a piece 38 cc. square.

Various cements for repairing glass, pottery, etc., are made of isinglass with alcohol and gums. A formula of cement of the following composition has been published: 10 grams of isinglass; 5 grams gum ammoniac; 5 grams mastic; 80 grams alcohol.

The isinglass and gums are said to be dissolved separately in the alcohol and then heated together over boiling water.[2]

Where a high luster is desired on textile goods isinglass is sometimes used, mixed with gum, as a size. Some silks are sized in this way. Mixed with pyroxylin and dissolved in acetic acid, with the addition of a little formaldehyde or potassium bichromate, it has been employed as a waterproofing composition for textiles. Isinglass dissolved in water is used to repair leather belts that have torn apart. In short, isinglass may be used as an adhesive wherever glue is used, but its cost makes it, for the most part, prohibitive for such service.

---

[1] Prollius, [illegible] (1881), 495.

[1] G. F. White, loc. cit.

[2] A large number of formulas for the preparation of special cements, insoluble or water resistant glues and glues for special purposes have been published. Some of these are undoubtedly workable and satisfactory, but a considerable number of them are either unworkable or unsatisfactory. For example, the above formula calls for a solution of isinglass in alcohol. Since alcohol is a precipitant for gelatin it is obvious that such a solution cannot be obtained. It is probable that the emulsion of an aqueous solution of the isinglass in the alcohol is indicated.

The "Working Clause" in Our Patent Law

A Consideration of the Stanley Bill and Its Effect Upon American Industry

By Albert E. Parker
Of Marks & Clerk, Patent Counsel; Member, New York
Patent Law Association

MANUFACTURERS, merchants and members of the patent profession are alarmed by the attempt that is being made in Congress to pass legislation which will largely destroy the patent system of the United States upon which so many important industries have been built up.

When the United States entered the war it was found that certain United States patents owned by German citizens or corporations could not be put into operation here, first because the inventions were not fully disclosed in the United States patents, or had not been commercialized here, although the product of foreign manufacture had been sold in the United States. Thus this country, it was alleged, was deprived of the use of important devices which it had been able to obtain previously, and it was not until legislation was enacted enabling the United States to take over the inventions and to have them manufactured that the inventions again were made available in this country.

Certain Senators, therefore, at the instigation of the War Department and members of the chemical industry, have had bills introduced in the Senate which would have a very disastrous effect on the country as a whole, in that they require that all inventions patented in this country shall be commercially worked within a limited time after the patents have been applied for. It is worthy of note that neither the Patent Office nor the Department of the Interior favor the amendment, nor were they consulted in connection with the drafting of the bills, although these bureaus are the Government agencies charged with the administration of the patent law and familiar with its provisions and their practical effect.

The Stanley Bill

The Stanley Bill, known as S. 3410, now before Congress, provides that any patent or patents issued in the United States under any act of our government shall be subject to the condition that unless they are worked or put into operation so as to result in actual production in the United States of the article disclosed in the patent within a reasonable time from the date of issue thereof, a compulsory license may be granted to a third party desiring to manufacture the invention giving him equal rights with the patentee to produce the article in competition with the patentee, no matter what the expenditure of the patentee may have been up to that time in preparing to market his device.

The bill is considered by the leading members of the Patent Bar in New York, Washington, Chicago and elsewhere a distinctly retrograde move. We have had no compulsory working provisions in the patent statute since the year 1832 and the provisions which then existed were only continued in operation for four years, the law having been repealed in the year 1836.

Objections to the Stanley Bill

The following are some of the grounds which were urged against the passage of this legislation:—

It strikes at the heart of our patent system, in that it would destroy the exclusive right of the patentee to his invention. This is the distinguishing feature of the patent law of this country that makes it superior to the law of any other country. For this reason, it would be equally bad for the public, the inventor and the manufacturer.

Endless litigation of a new kind would be induced, involving practically all of the questions that arise in infringement suits today, and endless controversies in ascertaining what is a "reasonable" time, within the meaning of the act, for working, and what is a "reasonable" royalty in any given case.

It would work a great hardship to one who had spent time and money in developing an invention of which there are several species or alternatives. In many industries, the success that had been purchased at the expenditure of hundreds of thousands of dollars would be appropriated by a competitor, who, having expended nothing, secured a license under any of the patented inventions not embodied in the final form of the machine manufactured; and, with such a license and the knowledge of the patentee's success and how it was attained, it would be a relatively simple matter for competitors, who had been at no expense, to bring out a machine that would actively compete and thereby prevent the patentee from securing an adequate return on his enterprise and investment. It is perfectly clear that this would put it in the power of a great corporation to entirely destroy its smaller competitors.

It would discourage, rather than promote, the progress of science and the useful arts, and would operate to suppress many more valuable inventions than it would liberate by the license. The owner of a controlling patent would discourage improvements of an alternative nature that he could not immediately manufacture as thereby his controlling patent would be destroyed.

It would discourage the investment of money to develop inventions; would inject an element of uncertainty and instability in trade, and would hinder progress and check investigation and industrial development.

The bill is ineffective for accomplishing its presumed purpose, in that in the case of patents for articles which are produced "in reasonable quantities" within the initial period of two to five years, it contains no provisions requiring any activity by the patentee after such period. Presumably, production in reasonable quantities would be satisfied by production in amounts sufficient to meet any demand that may have arisen within that time; and as during the first years of a patent the demand is at its minimum, a minimum production would satisfy the requirement of the bill.

Consequently, in most cases, a merely technical working would suffice. When this has been accomplished the patent becomes immune from any provision as to license during the entire residue of its term. Consequently, a wealthy foreign company could easily safeguard its rights here by accomplishing a minimum of technical working within the first five years, and afterward use the patents to exclude American competition while satisfying the demands of the American market solely by importing here the patented products made in its foreign factory. On the other hand, a poor inventor would be at a hopeless disadvantage.

An object sought by the Stanley Bill is apparently the implanting in this country of industries growing out of foreign inventions. This generally results from the existing patent law, and certainly cannot be any better attained by imposing conditions upon patents such as to discourage inventors. It is a proposition in economics rather than in patent law, and can be most effectively accomplished by tariff discrimination in favor of infant industries, or by other provisions of general law.

It is further urged that if the object of the proposed amendment to the patent law is to avoid a recurrence of the conditions named above, which hampered our preparations for belligerent operations upon our entry into the late war, this object can be secured without the enactment of legislation which would largely destroy the whole patent system of the country by imposing conditions upon the grant of patents in no way required for the national defense.

A condition under which a compulsory license can be secured by a competing manufacturer of a patented invention would undoubtedy discourage invention and deter business men from investing capital in developing and manufacturing new inventions. Under existing law the Government or its contractors may appropriate for governmental use any patented inventions and leave the patentees to recover compensation for infringement by a suit in the Court of Claims. If any extension of this power is necessary, it should be accomplished not by an amendment affecting all patentees, but by carefully guarded provisions limited to such patented inventions as are required for the national defense.

Another serious objection to the bill is that with many patented inventions the proposed working would be impossible because it would infringe prior patents covering earlier inventions. Thus the inventors of later improvements, however valuable, would be subjected to the unhappy alternative of working their patents by manufacture "in reasonable quantities," and thereby becoming liable for damages to the earlier dominating patentees; or of leaving their patents unworked and therefore open to invasion by the grant of compulsory licenses. The result would be grossly unjust to inventors of later improvements who would be forced to make terms with the owners of the dominating patents, who are usually large and wealthy corporations. This feature of the bill would strongly reduce the incentive to invention by men of moderate means.

So far as can be learned there has been no single supporter of this legislation from any member of the American Patent Law Association, the largest association of patent lawyers in the country; the New York Patent Law Association or the Chicago Patent Law Association, who between them number among their clients more than 75 per cent. of the manufacturers in all lines of activity in the United States.

These men know of the prejudicial effects to an industry of the imposition of working conditions as they have had to advise on means of endeavoring to comply with working requirements in the laws of foreign countries, and their united action in opposing the measure will, it is hoped, result in the abandonment of the attempt to pass retrograde legislation of this character. The Commissioner of Patents and also a number of ex-commissioners of patents are opposing the measure.

The United States admittedly has the finest patent law in the world. Its present industrial and commercial supremacy is due in large part to the liberality of our patent law and the fact that no manufacturing or working requirements exist to hamper the inventor and deprive him of the monopoly for a limited term guaranteed by our Constitution to promote the progress of the arts and sciences.

Chemical Plant Equipment Manufacturers' Association

In September, 1921, during the Chemical Exposition, a group of prominent chemical plant equipment manufacturers met at the Chemists' Club, New York, and appointed a committee to formulate plans for the organization of a trade association to be called the Association of Chemical Plant Equipment Manufacturers.

This committee is now ready to present its report together with plans, constitution, by-laws, etc., before those who are interested or have already joined such a tentative association. Accordingly a meeting has been called to effect permanent organization on Wednesday, May 10, at 10 a. m., at the Chemists' Club, New York.

Preliminary to the organization meeting will be held a meeting at the same place on Tuesday, May 9, at 8 p. m., at which present and prospective members will be addressed, among others, by E. W. McCullough, manager Fabricated Production Department, U. S. Chamber of Commerce.

Follwing the organization meeting at 10 a. m. on May 10, the association will hold a meeting at 2 p. m., when addresses will be made by Mr. Charles Roth, of the Chemical Exposition Company; Mr. Campbell, of the Boston Textile Show; Mr. Reeves, of the New York Automobile Show; and Mr. Ebertt, of the Ice Cream Supply Dealers' Association.

The objects of this association naturally are the furthering of the very many mutual interests of its membership. The matter of the exhibition feature is only one item, but since it is a comparatively vital one it will be given rather special attention at this time.

The importance of an industry equipped to supply the apparatus and engineering equipment needs of chemical industry and qualified to meet its progressive requirements cannot be overestimated, as was demonstrated during the extraordinary demands of war-time production. In an era of organization, it is remarkable that integration in this essential adjunct to chemical enterprise has been so backward.

Filled-Milk Manufacture Illegal

Chemical research and chemical business that made out of skim milk, fed to hogs and calves, a palatable and nutritious food product and created a market for a by-product of the farm, have received a setback in the enactment of "filled-milk" laws during the current "open" season for legislation in New York, Ohio, Wisconsin, Maryland, California, Colorado, Utah, New Jersey and Florida.

Agrarian interests classed the product with margarin in their antipathy to any product or enterprise that will make pure, wholesome food cheap. Their efforts to shut out the product or cripple it in competition have been rewarded with prohibition of its manufacture in the states mentioned. The New York statute reads as follows:

> "No person shall manufacture, sell or exchange, offer or expose for sale or exchange, or have in his possession with the intent to sell or exchange any condensed, evaporated, concentrated, powdered, dried or desiccated milk, cream or skimmed milk to which there has been added, or with which there has been mixed, blended or compounded, any fats or oils, other than milk fat, so that the finished product shall be in imitation or semblance of condensed, evaporated, concentrated, powdered, dried or desiccated milk."

Status of Domestic Vat Dye Raw Materials

A Plea for the Selective License

By C. J. Thatcher, Ph.D.
Vice-President and Technical Director, Thatcher Process Co., Inc.

AS a manufacturer of anthraquinone, which is the basis of alizarin, from which many of the vat dyes are made, I have a singular interest in the conservation and promotion of the domestic dyestuffs industry. The products of the Thatcher Process Co., Inc., are the raw materials from which alizarin and many of the vat dyes are made, which constitute the 10 per cent. of our dyestuff requirements, which at present are not made in the United States.

I devised the patented processes used by this company, which, in so far as I know, is the only one using electrochemical methods in the manufacture of intermediates and dyestuffs. We are preparing to enlarge our plant at Syracuse, N. Y., and to install a refining plant for our crude anthracene which will give us as a by-product, carbazol, also used in the manufacture of vat dyes. I have spent practically all my time since 1914 in devising, perfecting and patenting the processes we use, with the result that today we can turn out commercially the essential raw materials of vat dyes never before available to the American dyemaker in dependable quantities at satisfactory prices. With this assurance of domestic raw materials the development of American vat dyes should proceed apace.

However, every chemist or chemical engineer familiar with the subject will concede that the developmnt of the alizarin and vat dye industries is quite as difficult and expensive, if not more so, than what already has been accomplished. Contrast, if you will, the Germans' 20 years of intense application in the development of this branch of the industry with our just getting on our feet in the commercial production of even the essential raw materials. We will not need 10 years, but we do need more than one year to round out this branch of our domestic dyestuff industry.

The Selective License and Competition

My belief in the superior efficacy of the selective licensing system of protection as the fairest and safest method to insure independence in dyestuff manufacture, has been arrived at by careful investigation, the results and conclusions of which I have incorporated in the accompanying charts.

The conclusion enforced by the study of these charts is that, in the coal tar derivative industry, *ad valorem* protection creates monopolistic tendencies and a selective license protection destroys monopoly. While the chart represents only approximately the number of German and American manufacturers of coal-tar derivatives and their respective share of the markct at any period, all the data are of official origin readily available in government reports. The historical facts and statistics here collated demonstrate that *ad valorem* duties, rather than embargo or selective license, will, on the basis of past experience, tend to create monopolistic control of the dyestuff business. Alleging the contrary is on entirely mistaken premises. Even those opposed to embargo or selective license agree that such monopolistic control is not desirable. Thus apprised of the facts of the matter, their endorsement of a selective license should follow in order that there may be no creation of a monopoly in the industry in this country.

Not only is there no monopoly today but the surest way to prevent such condition is the continuation of the present system of protection by selective license.

Ad Valorem Duties and Monopoly

Why do *ad valorem* duties tend to create monopoly and why does the selective license tend to destroy monopoly in this industry?

The answer is to be found in the psychological effect which this form of tariff protection has upon the development chemist and upon the financier to whom such chemist must look for capital. Obviously if we are to avoid monopoly there must be inducement for continued activity of a considerable number of smaller, independent manufacturers who are willing to pit the experience and inventive skill of their chemists, backed only by modest capital, against the superior resources of larger, older organizations.

As one who has had during the past seven years much experience with the difficulties of financing new developments in the coal-tar derivative field, which might have to compete with larger, strongly-financed concerns, I can say for the technical research chemist and his financial friends that the war with Germany is not over insofar as the organic chemical industry is concerned, regardless of the representations of importers.

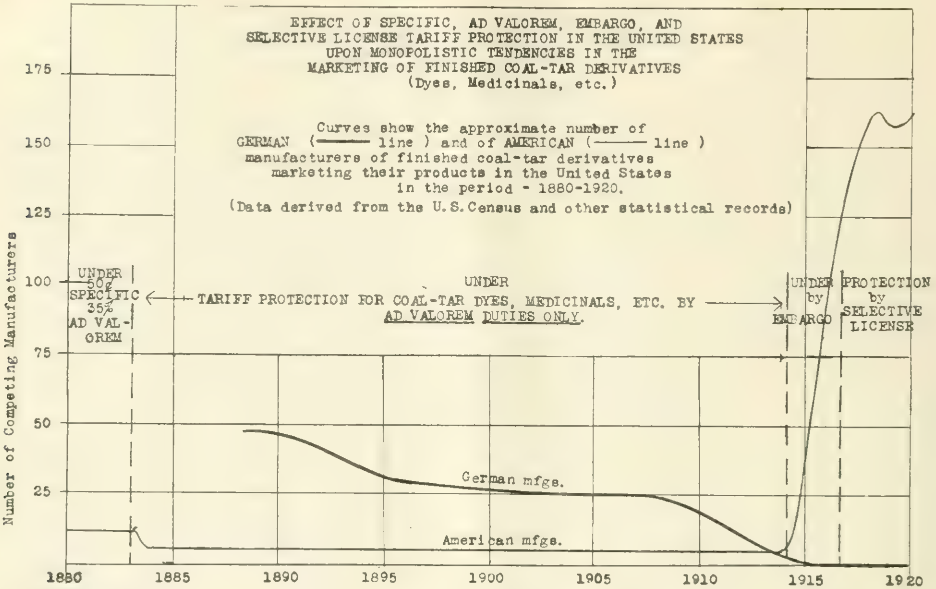
Reference to the chart will show the effect of various forms of tariff protection upon the development of the finished coal-tar derivative industry. The smaller independent American manufacturer under *ad valorem* duties cannot successfully institute new developments in competition with a highly organized and ruthless foreign competitor. It means that domestic competition will be reduced to a few large companies, if a form of tariff protection is adopted, which exposes the weaker manufacturer to unrestricted competition with the German trusts, before our coal-tar derivative industry is 100 per cent. developed; just as surely as a similar reduction did occur on a smaller scale in 1883 when a 50c per lb. specific duty was abolished.

Conclusion

I have taken pains to relate briefly my experience in the establishment of an American synthetic anthraquinone industry which is essential to the domestic production of the vat dyes now constituting the 10 per cent. of dyestuffs not made at present in the Unied States. In 1913 we imported 8,200,000 lbs. of the products of this industry and in 1915, 5,992,000 lbs. In 1920 we made in this country about 500,000 lbs. (exclusive of indigo derivatives) of these products, less than one-tenth of our pre-war consumption.

It is this domestic deficiency that the Germans could resort to in their "full line forcing," i. e., the American consumer should not have these valuable dyes unless he will buy all his requirements from German sources.

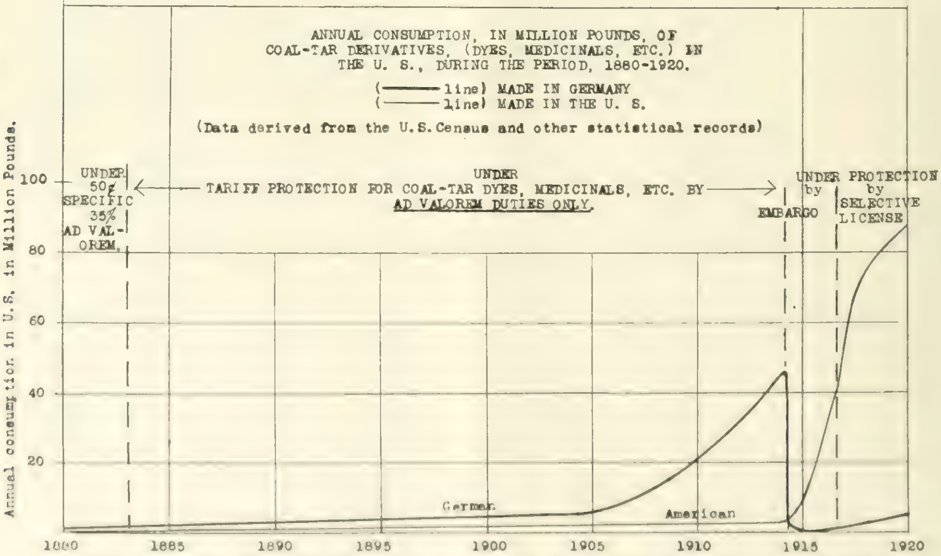
Do you not see how important and essential it is to self-sufficient independence in American dyestuff production that enterprise in this field I have described should be encouraged? Can you not realize the futility of any method of protection, other than the selective license for a reasonable period, to effect this end?



Removal of high Specific duty reduced domestic competition from 10 to 4 firms.

Thirty-two years of tariff protection by ad valorem duties only established Monopolistic Control of the finished Coal-tar derivative Industry in the U.S. by one German Trust, the I.G., formed by the combination of forty-eight original German manufacturers for foreign business. Four U.S. mfgs. remained in the field

Two years of Embargo and 5 years of Selective Licenses placed the industry in the hands of over 150 competing U.S. mfgs and 1 German Trust.



After thirty-two years of ad valorem tariff protection, 85% of the finished Coal-tar derivative Industry in the U.S. was in the hands of one German Trust, the I.G., and only 15% was supplied by four American manufacturers.

Two years of Embargo and 5 yrs of Selective Licenses placed 90% of the U.S. coal-tar derivative industry in the hands of over 150 competing U.S. mfgs.; the German Trust retained 10% only.

Compiled by C. J. Thatcher, Ph.D., [illegible]

It follows from these statistical facts, that
IN THE COAL-TAR DERIVATIVE INDUSTRY
AD VALOREM TARIFF PROTECTION CREATES MONOPOLIES
SELECTIVE LICENSE PROTECTION DESTROYS MONOPOLIES.

Current Chemical Patents and Patent Problems

By Lloyd Van Doren, Ph.D.
Consulting Chemist, Patent Attorney, The Chemical Foundation, Inc.

THE proposed revival of the Patent Treaty of 1909 with Germany under the terms of which German inventors should not be obligated to work their patents in this country, has riveted the attention of manufacturing chemists particularly to the effects which naturally would follow such revival. The Treaty with Germany lapsed as a result of the war. The question of its revival was presented to the President, who in turn referred to the Senate for authority to revive. The Senate granted this authority. It is deemed, however, that this action by the Senate was taken without full knowledge of the effects it would have upon American chemical industry, particularly the organic chemical branch.

The effect of its revival now has been presented to the President, the Senate and the Department of State, in view of which the attitude toward the revival of the treaty appears to have changed; whereby it seems highly probable that Legislation will be enacted requiring the working of patents within a certain period, or otherwise the monopoly rights thereunder will be forfeited. It requires but a brief survey of the condition in this country in the organic chemical field prior to 1914 to show clearly the result of the revival of the treaty and the absence of a working clause in our patent statutes.

Revival of the Patent Treaty and Organic Chemical Industry

We have at this time a struggling, but, nevertheless, a growing organic chemical industry, which if granted proper protection against the entrance of products from foreign sources and against the throttling possibilities of our present patent system, will survive and be of stupendous benefit to the country, from the standpoint of both national economics and national defense. Prior to 1914 it was unmistakably the practice of the German chemical companies to procure patents here on processes and products, not for the purpose of advancing industry in this country as was the intention under our Constitution, but for the purpose of retarding, and, if possible, as it was in many cases, to prevent the growth of an organic chemical industry.

The volume of patents granted to Germans and assigned to the various chemical companies, together with the non-application of them, clearly shows that the prime intent in securing these patents was to prevent development and to make this country dependent upon Germany as a source of supply for organic chemicals. Certainly a return to such a condition of dependence is not desired; in fact, would be fatal to self-sufficiency in innumerable essential commodities. The revival of the 1909 Patent Treaty would and could mean no other result than the return, in the matter of a few years, to the conditions which obtained in 1914.

The non-revival of the convention alone would not in itself thwart the hold which it is desired to gain over the American chemical industry, for it still would be possible for patents to be obtained without a requirement for working, and thus subject chemical industry to a severe obstacle. Suggestions by Senator Stanley and Senator Ladd looking to an obviation of this condition would, if enacted as law, prove a valuable support for the chemical industry.

It is true that American inventors are not required to work their patents in Germany and for this reason many large manufacturing interests are desirous of having the patent convention revived. There undoubtedly are logical and justifiable arguments from their point of view as to why a revival should be made, but there can be no question as to the effect which would accrue to the organic chemical industry in view of revival of this convention.

Senator Stanley's suggestion, which seems to be receiving more favor, would require that

> "any patent or patents issued to any person or persons under the provisions of this act shall contain a proviso to the effect that if such patent so granted is not worked or put in operation so as to result in actual production in the United States of the article embodied in such patent in reasonable quantities within a reasonable time from the date of its issue, which in no case shall be less than 2 years nor more than 5 years, the United States reserves the right to license any person or persons for purposes of manufacture in the United States, and to use and sell the subject matter thereof subject to the conditions hereinafter provided.

Which would appear to grant to the organic chemical industry that protection which is most needed.

The probability of the introduction of a working clause in our patent laws, which clause seems pre-eminently a necessity under the present patent conditions throughout the World, raises the question as to the general effect of working clauses upon progress in the arts and the internationalization of patents whereby the grant of a patent in one country would confer rights in all other countries. Such a condition it would appear, would tend to greatly augment industrial progress.

Irish Patents

Most recently the formation of the Irish Free State causes one to wonder whether it will now be necessary to secure patent rights in Ireland, in addition to the rights which have heretofore been embodied in a British grant. Previously a British grant gave to the inventor rights in Ireland. Will it now be necessary to secure additional rights through an Irish patent? The question of internationalizing patents is one which it appears should receive the attention of the Department of State.

Patent Taxes

Under present conditions our inventors are required to pay considerable sums in annual taxes on patents secured in foreign countries. It would seem that this burden will be increased because of the new jurisdictions which have arisen in Europe, viz., Polish, Austrian, Hungarian, Rumanian, Esthonian, Czechoslovakian, Jugoslavian, and other principalities which were previously included in a few jurisdictions. If this situation eventuates, only those with small fortunes will be able to avail themselves of complete foreign rights.

The effect of the requirement of many foreign patents and the taxes attached thereto is that the industries in these foreign countries may benefit through the endeavors of American inventors; whereas a foreign inventor may secure protection in the United States without taxation. This condition evidently should be remedied. It is deemed that the placing of a tax on a patent works to the detriment of industry in that it discourages rather than encourages invention. For in addition to the expenses incident to the grant, the inventor must carry the expense due to taxation, and this additional expense inhibits the exercise of his inventive power.

There is a further aspect in connection with the principle of patent taxation which, while seemingly giving to a foreign country the benefit of the enterprise of inventors in other countries, nevertheless in reality acts as a detriment to industry. For instance, if an American inventor should not secure patent protection in Belgium due to his inability to pay the annual tax, a Belgian manufacturer would hardly be inclined to exploit the invention and make expenditures for exploitation, when it would be equally possible for any other manufacturer to place the same product on the market and thus be benefited by the work which he has done in its introduction. The invention, therefore, would not be exploited and Belgian industry would be affected.

Internationalization of Patents

The internationalization of patents would seem to be the remedy for all such conditions. It would stimulate progress in the arts, since industrial progress is based upon invention, and invention in turn relies upon the protection granted by patents. It appears that an International Patent Office and possibly an International Court of Patents would prove to be of material assistance not only in the economic readjustment of the world, but to the acceleration of material progress.

* * *

Use of Synthetic Resin in Lacquers.

A lacquer or coating composition which shall contain as its principal constituent coumarone resin, is the subject of Patent No. 1,411,035, granted to J. M. Kessler, assignor to E. I. duPont de Nemours & Co. In addition to the coumarone resin the lacquer contains as a softening agent, China wood oil, the resin and oil being held in solution by a benzenoid hydrocarbon such as benzene, toluene or xylene.

The lacquers produced according to this method are stated to be well adapted for dipping and brushing purposes, to give a firm adhesive coating which sheds water, dries rapidly at normal temperature and is free from chalkiness on rubbing. Since these lacquers compare very favorably with the lacquers commonly known as the "gum" lacquers, and since they may be prepared at a relatively small cost, it is believed that they are in position to compete with the pyroxylin lacquers with which previously the gum lacquers could not compete because of their higher cost.

Recovery of Tungsten.

The recovery of tungsten values, especially tungsten trioxide from ores, concentrates, and other materials containing metallic tungsten, is described in patent No. 1,410,584, granted to Simon J. Lubowsky, assignor to Metal & Thermit Corp.

The tungsten trioxide may be obtained in the following manner:

The ore, or other material containing the tungsten, is roasted, together with a mineral salt, e. g., such as calcium chloride, sodium chloride, or potassium chlorate, the calcining being effected at a bright red heat, preferably at approximately 1700° F. The mass is then pulverized and treated for an extended time depending upon the character of the ore or tungsten-bearing material with a fairly concentrated mineral acid, such as sulphuric, nitric, or hydrochloric acid.

As a result of this treatment a large percentage of the original impurities of the ore goes into solution, which is separated from the insoluble residue. The latter which contains the tungsten values is washed and extracted with aqueous ammonia, or a solution of ammonium carbonate, preferably at about 60° C. The resulting solution is then evaporated and the ammonia is distilled off and recovered by any well known method. The residue from the distillation is then calcined at a dull red heat to drive off the last traces of ammonia, leaving the residue as a high grade substantially pure tungsten trioxide.

Nitro Cellulose Waste Used in a Paint Composition.

A paint composition which may be applied to asphaltic and like hydrocarbonaceous surfaces without the black color showing through and discoloring the paint, is the subject of Patent No. 1,410,790, granted to James H. Young, assignor to H. H. Robertson Co., of Pittsburgh.

The paint composition may be prepared as follows: Cellulose nitrate or products containing essentially cellulose nitrate, such as some photographic films, celluloid, etc., is dissolved in acetone. To this solution is then added enough ethyl alcohol to produce a solution of the following proportion by weight: 10 parts cellulose nitrate, 25 parts acetone, 70 parts ethyl alcohol, 5 parts castor oil.

To this is then added 10 parts of aluminum resinate and the whole is stirred until the resinate is dissolved. To this solution is then added 10 parts of powdered aluminum and 5 parts of green pigment, finely ground in alcohol. The whole is then thoroughly stirred together. By thinning this composition with a mixture of alcohol 70 parts and acetone 30 parts, it is possible to get a liquid of a consistency which may be brushed onto the asphaltic surface either mechanically or by hand, or it may be sprayed onto the surface or the asphaltic article may be dipped in it.

Upon standing, the volatile part of the solution evaporates, leaving a tough uniform film over the asphaltic surface which is light green in color and which has not been darkened nor streaked by the constituents of the asphalt upon which the film was produced. The film so produced consists essentially of the cellulose nitrate and pigments, but has in addition a filler (aluminum resinate) which gives body to the film and aids in preventing so-called "blushing" of the film during evaporation of the solvents.

Deodorization with Chlorine.

Patent No. 1,410,249, granted to Prof. Yandell Henderson, of Yale, and Howard W. Haggard, shows a process of deodorizing the effluent air from ventilating systems, consisting in injecting gaseous chlorine and moisture into the confined effluent air current, whereby as a result of the indirect oxidation the chlorine substantially removes all objectionable odor, and then allowing the discharge of said air to the atmosphere.

Phosphoric Acid by the Electric Furnace.

The great variety of uses for phosphorus-containing compounds has led to many methods for obtaining the phosphorus in a utilizable form from phosphorus-containing minerals. In the effort to recover the maximum content difficulties have arisen which render the recovery of the last few per cent. of the phosphorus almost impossible of realization from a commercial standpoint.

An improvement which permits regulation, with substantial accuracy, of the composition and purity of the phosphoric acid product, hence giving an acid which is at once available for food and medicinal purposes, as well as reducing the waste of the phosphorous-content of the rock to a minimum, depends upon charging into an electric furnace (1) iron-bearing materials, the iron-content of which is definitely known, (2) phosphate rock, in such proportion to the iron that there will be produced an iron-phosphorus alloy of desired composition, (3) carbon in sufficient quantity to reduce the phosphorus from the phosphate rock, and (4) sand or other acid flux to combine with the lime or other base material, and form compounds which will give to the slag the required fluidity and acidity.

The process may yield either meta, pyro or orthophosphoric acid, depending upon the temperature at which the evolved gases are maintained; for instance, if the temperature is maintained at approximately 350° C. meta-phosphoric acid is produced, if at approximately 215° C. pyro-phosphoric acid is produced, and if a temperature is maintained at 210° C. pure ortho-phosphoric acid is produced, and by further reduction of the temperature it is possible to obtain an ortho-phosphoric acid of any desired strength.

The phosphoric acid produced is markedly free from arsenic and lead compounds and may be obtained in a high concentration which renders it well adapted for shipment. The method renders possible the production of pyro and meta phosphoric acid in a manner much simpler than previous methods which depended upon very prolonged heating. An additional advantage is possessed by the meth heating. An additional advantage possessed by the method is described in patent No. 1,410,500, to John N. Carothers, in that the necessity of subjecting the gas from the furnace to successive electrical field strengths, in order to precipitate and collect the phosphoric acid is avoided.

(To be Continued)

Personal Items

Harry Eastwood, formerly at the Kansas City plant, American Radiator Co., is now chemist, Cook Paint & Varnish Co., Kansas City, Mo.

* * *

Frank Z. Woods, manager, Chicago office Rockhill & Vietor, New York, which has discontinued business, will take over the essential oil department.

* * *

Charles F. Hobson, formerly general manager, Westchester Chemical Co., Pelham, N. Y., is now with the Wamesit Chemical Co., Lowell, Mass.

* * *

C. W. Bedford has resigned from the Rubber Service Laboratories Co., Akron, Ohio, to enter the research department of The B. F. Goodrich Co.

* * *

Hugh M. Henton has resigned as instructor, Case School of Applied Science, to engage in independent practice at National City Building, Cleveland, Ohio.

* * *

H. T. Herrick, formerly chemist at the Lock Haven, Pa., plant of the American Aniline Products Co., is with the By-Products Steel Corp., Wierton, W. Va.

* * *

Gustave E. Behr, Jr., formerly superintendent, Balder, Adamson Co., Philadelphia, Pa., is now with the National Lead Co. at its Brooklyn, N. Y., laboratory.

* * *

Thorwald A. Carlson, formerly at the East Helena, Mont., plant of the American Smelting & Refining Co., is now with the Forest Products Laboratory, Madison, Wis.

* * *

Allen V. de Ford, formerly with Musher & Co., Baltimore, Md., is now with the Vegetarian Food & Nut Co., manufacturers of peanut products, Washington, D. C.

* * *

John F. Queeny, chairman, board of directors, Monsanto Chemical Works, St. Louis, Mo., completed on March 28 a half century of activity in the chemical industry.

* * *

C. E. Skinner, manager, research department, Westinghouse Electric & Mfg. Co., has been appointed assistant director of engineering. He is succeeded by S. M. Kinter.

* * *

Arthur D. Holmes, research chemist Jackson Laboratory, E. I. du Pont de Nemours & Co., has resigned to establish a research laboratory for E. L. Patch & Co., Boston, Mass.

* * *

Alvin C. Goetz, formerly of the by-products division of the Southern Cotton Oil Co., is now superintendent of the fatty acid distillation plant of Darling & Co., U. S. Yards, Chicago.

* * *

C. A. Mace, formerly with the Ciba Co. and well known in the dyestuffs sales field, is now with the Butterworth-Judson Corp., 30 Church Street, New York, in charge of dyestuffs sales.

* * *

H. G. Brown, for the past 10 years with Hyde, Rakestraw Co., Philadelphia, Pa., and Turner, Halsey Co., New York, has joined the sales staff of the Atlantic Dyestuff Co., Boston, Mass.

Dr. Charles D. Woods, formerly director of the Maine Agr. Exp. Station, is now director of the division of agricultural information of the Massachusetts State Department of Agriculture.

* * *

C. A. Hemingway, formerly in the manufacturing and sales departments of the Firestone Tire & Rubber Co., has joined the sales staff of the Wishnick-Tumpeer Chemical Co., Chicago, Ill.

* * *

L. E. Roberts, formerly assistant director of research, American Writing Co., Holyoke, Mass., is now physical chemist, Pacific Coast Experiment Station, Bureau of Mines, Berkeley, Cal.

* * *

Robert D. Landrum, formerly chemical engineer, Harshaw, Fuller & Goodwin Co., Cleveland, O., is now vice-president Vitreous Enameling Co., Cleveland, O., in charge of development and sales.

* * *

Dr. Theodore W. Doell, formerly with the du Pont organization, is director of the Industrial Chemical Laboratories, Oakland, Cal., recently established to engage in consulting research and analytical work.

* * *

Lewis Colwell, Chicago, Ill., has been appointed sole sales agent and consulting engineer for the exploiting of the patent of Mariz Weinrich, New York, for the manufacture of vegetable decolorizing carbon.

* * *

C. S. Brinton has been appointed chief of the Philadelphia Food and Drug Inspection Station of the Bureau of Chemistry to succeed Arthur Stengel, who has been transferred to the Bureau at Washington.

* * *

William E. Schoenfeld, formerly of Newport Chemical Works, Inc., has organized, with George H. Davis, the Alpha Dyestuff Co., 155 Broadway, Brooklyn, N. Y., to engage in the general dealing and testing of dyestuffs.

* * *

Wm. M. Corse, formerly general manager Monel Metal Products Corp., succeeds H. E. Howe, in charge of the division of research extension of the National Research Council, in connection with his private practice.

* * *

George A. Miller, Jr., for the past five years chief metallurgist, Frankford Arsenal, Philadelphia, Pa., is now chief chemist and general manager citrus products manufacture, Lakecrest Citrus Products Co., South Lake Wier, Fla.

* * *

A. J. Wadhams has been transferred from the managership of the Bayonne, N. J., refinery of the International Nickel Co., 67 Wall Street, New York, to the new department of development and research. Dr. Paul D. Merica will be associated with him as director of research.

* * *

Homer F. Staley, until recently metallurgical ceramist, Bureau of Standards, Washington, D. C., is now ceramic engineer with the Metal & Thermit Corp., 120 Broadway, New York, in charge of its ceramic department which has placed on the market tin oxide for use in the manufacture of enamels for sheet steel and cast iron and in the making of glazes for sanitary pottery and terra cotta.

Industrial Notes

Redmanol Chemical Products Co., Chicago, Ill., has allied with the Condensite Co. of America, Bloomfield, N. J., through the medium of a common majority stock ownership.

* * *

The H. W. Johns-Manville Co., New York, has resumed the construction of its $3,000,000 plant at Waukegan, Ill. The erection of the plant was stopped more than a year ago on account of the business depression.

* * *

The Essential Oil Co., Trenton, N. J., Gustave Mahlck, manager, a subsidiary of the American Linseed Co., has taken over the former works of the American Brass & Lamp Co. in that city and plans the early production of terpineol and allied synthetics.

* * *

Butterworth-Judson Corp., 61 Broadway, New York, manufacturers of acids, intermediates and dyestuffs, has discontinued the distribution of its dyestuffs through L. M. Bowes trading as the Standard Color Co., and will market all its products through its own selling staff. After April 8th the sales offices will be at 30 Church St., New York.

* * *

The Darco Corporation, Wilmington, Del., a subsidiary of the Atlas Powder Co., manufacturer of carbon products, will build three plant units at its new works at Marshall, Tex., instead of a single unit, as previously intended. The plant is estimated to cost in excess of $500,000, including power house and other structures. Work on the first unit is under way.

* * *

The Federal Court at Louisville, Ky., has appointed receivers for the Kentucky Distilleries & Warehouse Co. The company owns 5 distilleries and is said to have 123,000 bbls. of bonded whiskey in its 20 warehouses in that state. The Kentucky Distilleries & Warehouse Co. is controlled by the Distilling Co. of America, which in turn is a subsidiary of the U. S. Food Products Co.

* * *

Congregation of the General Chemical Co., 25 Broad St., National Aniline & Chemical Co., 21 Burling Slip, and the Barrett Co., 17 Battery Place, in the new 17-story Barrett Building at 40 Rector St., corner West St., New York, is in process. The other constituent companies of the Allied Dye & Chemical Corp., viz., Solvay Process Co. and the Semet-Solvay Co., will have New York offices at this address.

* * *

The Freeport Sulphur Co., New York and Freeport, Texas, awarded contract on March 24 to Dwight P. Robinson & Co. for the design and construction of a complete sulphur mining plant at Hoskins Mound, Texas, where it has taken over the sulphur lease of The Texas Co., including the sulphur wells that have been drilled. A railroad connection is to be made at once and the Freeport Sulphur Co. is to install a modern plant and have it in operation by April 1, 1923.

The Freeport Sulphur Co. assumes payment of $1 per ton royalty to the land owner, the Mound Company, and The Texas Co. is to receive a contingent royalty as follows: An amount corresponding to 30% of the net profit until the Freeport Sulphur Co., out of the remaining 70%, has realized the amount of its plant investment with interest thereon at 6%, and thereafter an amount corresponding to 70% of the net profits. Cloyd M. Chapman has been retained by the Freeport Sulphur Co. as consulting engineer.

The U. S. Industrial Alcohol Co. reports for the year ending December 31, 1921, a net loss of $572.047, after charges, depreciation and inventory adjustment, as against a net income of $3,339,490 for the preceding year. The Allied Chemical & Dye Corp., for the same period reports a net income of $7,646,909, as against a net income of $16,179,939 for the preceding year.

The business conditions reflected by these reduced incomes are now happily past, with present assurance of increased demand for the varied products of these concerns. President William H. Nichols of the latter organization supplemented his statement of last September that after 6-7 years of research and experiment the problem of atmospheric nitrogen fixation has been solved to the entire satisfaction of the inventors and the corporation, with the announcement that "the most conspicuous technical development during 1921 was to establish successfully, on an industrial scale, the manufacture of anhydrous ammonia directly from the nitrogen of the air. The new plant for this purpose has been running steadily at capacity since it was completed last fall, and is the first of its kind to be operated successfully in this country."

* * *

Bonn & Co., 511 Fifth Ave., New York, have acquired an interest in the North and South American rights to the Casale ammonia process and will develop its application to the fertilizer, refrigeration and chemical industries on this side of the Atlantic. The Casale ammonia process is said to fix atmospheric nitrogen as pure ammonia at much lower installation and operating costs than is possible by any fixation processes now in operation.

The administrative personnel of Bonn & Co. comprises A. E. Bonn, president, who formerly was general sales manager of the American Cyanamid Co. and vice-president of the Air Nitrates Corp.; G. A. Hendrie, vice-president, who formerly was assistant to the vice-president of the American Cyanamid Co. E. J. Winter, formerly chief engineer of the same company and more recently consulting engineer of United States Food Products Corp., is also associated with Bonn & Co.

Equipment is nearing completion for standard Casale ammonia plants in Japan, France, Spain and Norway. The units erected in Italy are in regular operation and are said to have exceeded in every respect the early claimed efficiencies of this revolutionary process developed by Prof. Casale during the war period.

POSITION WANTED

YOUNG MAN, 1921 Graduate in Chemistry, desires position. Broad training in analytical and metallurgical chemistry. Now teaching chemistry in High School of large city. Some experience in Insecticide work. Age 26; single; at liberty June 10th. Address H 1, care of CHEMICAL AGE.

VACANCY TO FILL

WANTED: Sales Engineer, experienced in selling, and possessing competent engineering knowledge of evaporation and distillation work. Please give age, educational qualifications, salary desired, amount of experience in above lines, and training as draftsman and designer. References required. Address P 41, care of CHEMICAL AGE.

CHEMICAL
AGE
A CONSOLIDATION of THE CHEMICAL ENGINEER and CHEMICAL AGE
LLOYD LAMBORN, *Editor*

VOLUME 30 NEW YORK, MAY, 1922 NUMBER 5

The Field and Functions of Trade Associations in American Industry

The Consideration of Their Coöperation with Government in the Elimination of Waste

By Herbert Hoover

Secretary, Department of Commerce

HERBERT HOOVER,
Secretary, Department of Commerce

ONE of the oldest trade associations in the country is the Manufacturing Chemists' Association of the United States which has completed a half century of activity. Representing the common interests of a large field of chemical enterprise created by the emergencies of war is the Synthetic Organic Chemical Manufacturers' Association now in the second year of its existence. These two trade associations represent in a way a division of the field of chemical manufacture into the basic heavy chemicals and the finer organic chemicals of application chiefly in dyeing, medicine, perfumery, photography, etc., and produced by industries based on benzene and its homologues, derived from coal tar.

In process of organization is the Chemical Equipment Association, in the encouragement of which W. A. Durgin, chief of the Division of Simplified Practice of the Department of Commerce, spoke at its meeting at Rumford Hall, New York, on May 10th. These trade associations, together with the Association of Scientific Apparatus Makers of U. S. A. represent in chemical industry a movement which in recent years has covered all industry and which has its impetus in the experience of men that in organization there is strength to do what the individual, as a rule, is powerless to do in obedience to the urge of progress.

While the efficiency and ability of our individual business men and industries are of a high character, there are many questions of general interest that they cannot compass without common action. This has resulted in the organization of chambers of commerce and associations among bankers, merchants, manufacturers, parallel with associations of farmers, lawyers, doctors, engineers, workers and many other groups.

The multiplication during the past twenty-five years of literally scores of hundreds of associations in these activities means a groping for some vital necessity in our whole system. The benevolent results to the community obtained in thousands of instances is proof of their value. One of our constant national problems is how to obtain these benevolent results of such co-operation without creating domination by groups that would stifle equality of opportunity; to obtain them without loss of individual initiative; to obtain them and still maintain that competition among individuals which is the sustaining impulse toward progress. I do not believe these things are incompatible.

The legitimate associations in industry and commerce have been well proven to be in public interest. We need only to examine the many functions of the two thousand organizations to demonstrate this.

Activities of Trade Associations

Chambers of commerce and trade associations have in their own field concerned themselves with the promotion of our foreign trade, with better preparation of goods to meet the necessities of different markets, with securing of credit information in foreign markets as to foreign dealers, with the dissemination of information as to possible demands, with the supply of goods from competitive countries, the character of these supplies, the customs regulations, transportation of goods, port and warehouse conditions, support of our merchant marine and a thousand items that make for the advancement of our foreign commerce.

They have concerned themselves with the collection of domestic credit information, with the handling of insurance in different forms for their members, with standardization of quality and grades of their commodities and products so that the public may have reliable grades, and some have supported inspection to see that these qualities are maintained. They have concerned themselves with simplification of trade terms, elimination of unnecessary varieties in dimensions of different articles, with conduct of arbitrations, with joint advertising of products of the industry, with securing prevention of infringement in trade marks and designs, the promotion of welfare work in the organization of employees, with employment insurance, with the problems of apprenticeship and trade education and the prevention of accidents. They have raised the standards of business ethics in many trades. They have concerned themselves with representing the views of the trades in legislation on tariff, taxes, transportation, etc. They have concerned themselves with freight rates, overseas transportation charges, uniform bills of lading, with statistics as to production and stocks of goods, with scientific accounting, selling and with scores of other activities, all of which make for improved business practice.

It would be possible to demonstrate that these activities have resulted in great savings in costs of production and distribution amounting to enormous sums of benefit to both producer and consumer.

Furthermore our costs of distribution and manufacture have increased greatly due to increased taxation and other burdens we cannot avoid. If we would reduce these charges and thereby enable farmers to buy more and to increase our employment, we must advance in every direction to further decrease these costs and eliminate wastes that we can find.

Self-Preservation Compels
Cooperation of the Little Fellow

There is one generalization in connection with this movement that has been mostly overlooked. The trade association in membership is predominately made up of the smaller establishments. Big business can employ its own agents in all these matters. It can establish its grades and standards, it can employ its own research laboratories. Little business can only hope to be equally informed and make equal efforts to promote its welfare through trade associations.

Attitude of Department of Commerce

The law provides that the Secretary of Commerce shall promote trade, industry and transportation. In the reorganization of the Department of Commerce that it might become of far greater real service to our whole public we have sought to co-operate with industrial and commercial organizations, agriculture and labor in promotion of marketing abroad, in employment, in transportation, in elimination of wastes and improvement of our industrial technology, statistical services and information, and in many other directions.

These problems become practical problems of day to day contact with commerce and industry, if we would learn the direction in which real service can be accomplished. Such contact can only be secured through trade and industrial organizations, for without organization there can be no representation. We hold that legitimate trade association work is vital and should be encouraged.

Certain doubts have been raised as to the right purpose of all trade associations during the past year by the exposure of a few groups that have taken advantage of the benevolent purposes of trade association work as a cloak to create combinations through which they not only restrained trade but some of them also became the nuclei of corruption. I wish to state at once that a canvass of nearly two thousand trade associations showed that only a small minority were engaged in those functions which lay the foundations upon which restraint of trade is suspicioned.

Recently this Department addressed to the Attorney General certain questions for its guidance in its relation to various functions of associations and received his views thereon, which have been communicated to the public. I cannot, nor would not, add nor subtract anything from what the Attorney General has stated. The Department of Commerce cannot interpret the law and has no intention of doing anything of the kind.

It is obvious that the Department of Commerce cannot establish co-operative relations with associations who maintain types of practices that have been condemned by the courts. Beyond this again there are some two or three functions carried on by a small minority of trade associations, the legality of which has been questioned but not yet determined. These are in the main the so-called open price associations which are collecting data on prices and sales of their individual members, and circulating such individual data again to their members together with certain other activities.

I wish to state frankly and at once that the officers of the Government do not believe that these functions are in public interest, whether they are used in violation of the law or not. The Department laid down the rule nearly a year ago that it could not co-operate with associations subject to such criticisms and sees no reason to change it.

The labor unions solved this matter in securing legislation giving them practical immunity from the restraint-of-trade laws. Lately the farmers have done the same. The commercial and manufacturing community has not asked for more than some interpretative help in questions along the twilight zone of trade restraint. The Federal Trade Commission was originally conceived in the sense of providing some measure of interpretation of the law but these provisions were largely stricken from the original legislation.

Lately Senator Edge and Congressman MacArthur have introduced into Congress a proposal for a joint congressional inquiry to be held for the purpose of considering this situation. I believe it would be in public interest if the experience of recent years were inquired into by such a committee. The problem is not one of purely legalistic interpretation for in the final analysis much must depend upon the economic and social results to the community.

The whole commercial community is vitally interested in the limitation of co-operative action in the necessary prevention of restraint of trade. It is the duty of the Department to study the economic effect of this law. The real problem is to avoid destroying the good in uprooting the evil. Men have been murdered with brickbats but that is no reason for prohibiting brick houses.

But after all these questions of the twilight zone are very secondary. The functions that are challenged are so small a part of trade association work and so unim portant in the larger matters of commerce and industry that the associations in vast majority concern themselves with.

In the matters of day to day co-operation that go on in connection with trade organizations, I wish to emphasize that the efforts of the Department of Commerce are purely co-operative. They are not imposed upon anyone. We do not want any relations that are not based upon an expressed wish to establish such co-operation in the advancement of the different industries.

Foreign Trade

Our foreign trade is one of intense and different technology in every different commodity. Moreover, the laws, customs, transportation, the demand and supply problems vary with every commodity in every country in the world. Congress over many years had given support to a large foreign staff seeking to serve the American farmer, manufacturer, exporter in these matters. These staffs were comprised of men of general trade knowledge, but they were not specialists. No mortal could possess the special training required for all commodities for all countries.

Congress, therefore, approved our recommendation that the Foreign Trade Division of the Department of Commerce should be divided into specialized branches. Even something more than specialists in a department were needed for we must obtain intimate contact with the men in the different industries themselves. We, therefore, co-operated with several trade associations to appoint special committees who should give direction and strategy to our agencies abroad on behalf of the whole industry. The result has been to place these energies in the channels where the sale of actual goods has been promoted; to dictate the character of information needed for their special trades, to promote the economic handling and reduction of risks in foreign business.

This basis of co-operation so far as has been developed is beyond our highest anticipations. The growth of inquiries from the commercial public to this division from a few hundred daily to several thousand daily is only one evidence of the usefulness of this co-operative effort. I do not wish to lay too much emphasis on this service; it is worth noting that our foreign trade has decreased in less proportion to pre-war than that of the other nations of the world and I believe the devoted work that we have received from American business men in this particular has saved us from much larger decreases and promises much for the future. We would be glad to extend it to other industries.

Simplified Practice

We have entered into joint work with various trade associations in the advancement of their efforts of simplification of trade terms, in the simplification of general specifications, simplification of dimensions of many and varied products, all of which makes for cheaper production, cheaper distribution, emphasizes competition and ultimately benefits the consumer as well as the producer.

We have co-operated in carrying out investigations into the technical processes of manufacture with many different industries, thus having the advantage of men of practical experience from the trade associations in co-operation with our scientific staff. The whole of this field of elimination and utilization of waste is one of the most important before our commercial and industrial development and one than can be accomplished only by co-operative effort on scientific lines.

Statistics of Production and Distribution

We have had much co-operation in the development of the Government service devoted to publication of statistics on production and distribution of commodities. These services had existed in the Government for many years and the problem was to make the materials of greater value to the commerce of the country. In these matters we have had the co-operation of many trade associations. These services need further development in the interest of the whole community. Statistical information as to productivity and national stocks is needed not alone by the man in a particular industry but the same information is needed by men in other industries and it is needed by every agency of the Government.

A study of the trend of production and consumption does not imply restraint of trade. If it does, then the whole statistical basis of commerce that fills one-third of our newspaper space would need to be abolished. If we abolished it we would be bankrupt in ten years. The matter that I am principally interested in is that this information should be available to the whole public. It is the old question as to whether a community will succeed if it acts in ignorance or if it acts in knowledge.

Cooperative Research in Cotton Manufacture

The research department of the National Association of Cotton Manufacturers, recently established under the direction of R. T. Fisher, formerly assistant chief of the textile section of the Bureau of Standards, will have the cooperation of an advisory committee of which F. S. Blanchard is chairman. In the program of this committee the principle of standardization of methods of testing is emphasized in the following statement:

"One of the first things which it is thought desirable for the Association to adopt is a uniform method of testing in their mills or laboratories. This would eliminate one of the constant sources of confusion which arises whenever the subject of strength is mentioned. To find out what methods of test are in use by the Association it may be advisable to send out a questionnaire asking for the details of testing. This would ask for such information as type and capacity of testing machine, hand or power driven, size of test specimen and method of correcting for moisture content.

"After this information has been collected if a large enough group of mills are using the same method of test it may be possible to compile tables showing the average strength of some yarns and fabrics under certain fixed conditions. Accurate information of this nature is for the most part not obtainable and would have a wide application if it could be furnished.

"Any information given to this department will be considered strictly confidential unless otherwise specifically stated."

H. A. Ordway, 25 Church St., New York, succeeds his father, the late Charles Ordway, in the evaporator business at the above address. Charles Ordway, prior to his death on April 29, had been identified with evaporator engineering for thirty years, having been associated first with Homer T. Yaryan, inventor of the evaporator of that name. Mr. Ordway succeeded the Yaryan Co. in 1916, with which he had been connected as consulting engineer.

Lactic Acid and the Tariff Schedule

THE dependence of many branches of domestic chemical industry upon the enactment of tariff rates that will permit the continuance of the American industry, is illustrated in the history of lactic acid manufacture, an industry of American origin. Charles E. Avery founded the industry at Littleton, Mass., in 1881 as the Avery Lactart Co., which in 1895 became the Avery Chemical Co., which produced, in 1897, 400,000 pounds of technical lactic acid and established agencies abroad.

Americans developed its manufacture as a fermentation product of starchy materials, and its chief uses as a bating and plumping agent in the tanning of hides, in the dyeing and printing of textiles, as a pharmaceutical, beverage ingredient, and as a constituent of baking powder. The first foreign plant was built at Nieder Ingelheim, Germany, in 1896. The German industry developed so rapidly that its exports prior to the war were estimated as twice as great as the American production. In Germany potatoes are the chief raw material; in America, inferior grades of corn and the vegetable ivory waste of the button industry.

In 1917 there were five American manufacturers of lactic acid with an output of over 1,900,000 pounds (100% basis), which was increased to over 5,000,000 pounds in 1919. In 1921 German imports amounted to 603,385 pounds, which were marketed at a price prohibitive of continued domestic production because of the disordered economic conditions in Germany.

Robert F. Marden of the Wamesit Chemical Co., Lowell, Mass., in a communication dated March 30, 1922, which was incorporated in the legislative consideration of the tariff schedule on lactic acid, stated:

> "The Wamesit Chemical Co. is closing down its plant today, having its tanks filled to overflowing with manufactured lactic acid which we have been unable to sell in any great quantities, largely because of German competition. We are willing to make due allowance for hard times, but it is the German competition which strangles our industry, whether times are good or bad.
>
> "It is not my desire nor that of my associates to seek to procure an unreasonable tariff protection, but we feel strongly that we are entitled to a sufficient protective duty, because we are not only an enterprise serving private industries, but, on the other hand, engaged in a line of vital importance to this Government in the event of war. We do not believe that we should be compelled to abandon and dismantle a valuable productive enterprise, which will be, however, the ultimate fate of the Wamesit Chemical Co. unless we have relief as outlined above. The figures we have asked for are, to our mind, the minimum protection that should be given us."

John H. Murphy, treasurer, Wamesit Chemical Co., in a prior communication, dated February 16, 1922, says:

> "Upon investigating we find that the exceedingly low cost of labor (about one-twentieth of our cost) and the extremely depreciated value of the currency (which is now over 2,000 per cent. below normal value) in foreign countries of manufacture, make it possible for the foreign manufacturers to produce and sell in this country far below our cost of production, and, of course, at a price at which we can not compete.
>
> "To these facts is also attributable our loss of all of our export business. We also attach a certified copy of our balance sheet covering our operations during the last six months of 1921, the last period for which figures are available, showing a loss to our company of $10,709.96.
>
> "Our foreign market has been taken away from us absolutely and our domestic market is rapidly disappearing. To enable us to continue manufacturing an article the manufacture of which was started in the United States 37 years ago, we must have adequate protection in the shape of duty; specifically, we wish to have amended the proposed tariff schedule as it is printed in the bill on page 2 as follows:
>
> "Substitute 5 cents for 1½ cents on line 8.
>
> "Substitute 10 cents for 3 cents on line 10.
>
> "Substitute 15 cents for 5 cents on line 10.
>
> "Add a clause providing a duty of 25 cents per pound on edible lactic acid.
>
> "With these amendments we feel that American manufacture of lactic acid in existing plants can be conducted without constant fear of competition from foreign importations, and, at the same time, without giving lactic acid undue protection. In short, in order to continue the operation of our plant, it is necessary to increase the protective tariff on lactic acid as suggested above.
>
> "The following-named companies, which have in the past manufactured considerable quantities of lactic acid in the United States at the places named, have stopped manufacturing, and will not resume for the reasons stated.
>
> "American Alkali & Acid Co., Bradford, Pa. Found it unprofitable.
>
> "Atlantic Chemical Co., Mansfield, Mass: Failed.
>
> "Avery Chemical Co., Lowell, Mass.: Failed and plant purchased by Wamesit Chemical Co.
>
> "Westchester Chemical Co., Pelham, N. Y.: Found it unprofitable and have discontinued business.
>
> "We serve several manufacturers in New England; some are small consumers; others are quite large consumers. Due to our ability to effect immediate and prompt deliveries of high-quality acid, to convenience, established business relations, and friendships, we have held the bulk of the business in our immediate vicinity, and these users particularly would suffer if we were forced to discontinue and leave the market to the mercy of the foreign manufacturers, who would undoubtedly not be slow to take advantage of the situation and raise prices.
>
> "The high monthly average of lactic acid importations in 1921, were surpassed in January, 1922, which have come in despite the fact that lactic acid should not have been permitted to enter except when a license was granted by the chief of the dye and chemical section, Department of the Treasury, covering such importation. Some importations were made without licenses. The importers resort to various subterfuges to get lactic acid into the country. While they have been succeeding in this, we have been piling up manufactured lactic acid in our tanks and meeting with constantly increasing difficulty in finding a market.
>
> "In summary, we can produce both edible and technical lactic acid in the volume and of the qualities required by consumers in the United States, and sell same at reasonable prices consistent with the prices which prevailed before the war plus the extra cost of production due to higher cost of labor, coal, raw materials, repairs, etc. We can not compete with the importer of foreign lactic acid unless we have a safe margin of protection in the tariff."

We have submitted the present conditions affecting the domestic lactic acid industry because it is one of American origin and development, and because it typifies the economic situation confronting our synthetic organic chemical industries. These latter have been created by the emergencies of war conditions, without which America doubtless never would have attained the impetus to self-sufficient independence in many of the essentials of modern civilization.

Do you not now appreciate the uncertainties that face the American chemical technologist and the ramifications of the problems of statecraft?

Ross E. Gilmore, formerly chief chemist, Standard Chemical Co., Montreal, has been appointed superintendent, fuel testing laboratories, Dept. of Mines, Ottawa. He is succeeded by E. A. Smith

* * *

The annual report of the secretary of the New York Chemists' Club shows accession of 128 members during the year, with losses of 25 by death, 136 by resignation, 74 dropped for non-payment of dues, and 14 suspended for the same cause.

The Future of Nitrogen Fixation in the United States

By J. K. Clement

Major, Ordnance Department, U. S. A.

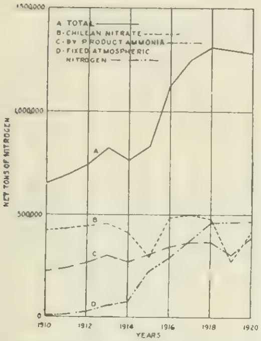


Fig. 1. World's Production of Nitrogen.

THE future of nitrogen fixation in the United States will depend in large measure on the relation between the demand and supply of inorganic nitrogen. The world's production of inorganic nitrogen during the decade from 1910 to 1920 is shown graphically in Fig 1. The total production in 1910 was 654,000 tons. By 1913 it had increased to 823,000 tons and in 1918 it amounted to 1,300,000 tons.*

The increase in production was most rapid in the case of fixed atmospheric nitrogen and least rapid in the case of Chilean nitrate. The war demand increased the Chilean production only ten per cent.—from 450,000 to 500,000 tons. The production of by-product ammonia increased from 220,000 tons of nitrogen in 1910 to 390,000 tons in 1920. During the same period, the production of fixed atmospheric nitrogen increased from 10,000 tons to 467,000 tons.

National Sources of Inorganic Nitrogen

Table 1 shows the national production capacities for inorganic nitrogen other than Chilean nitrate in 1921. It will be noted that Germany leads with more than half of the world's total capacity. The United States, Great Britain, and France follow in the order named.

On account of the enormous development of fixation plants in Germany during the war, it has been predicted that Germany will have a large surplus of ammonia for export. In this connection a book published in Germany in 1921 by Walter Eucken[1] is of interest. Eucken places the capacity of fixation plants at 310,000 metric tons of nitrogen. He finds that if the future requirements are only equivalent to the requirements of 1913-1914, on account of the reduction of the manure supply, Germany will require 445,000 metric tons (490,000 net tons) of artificial nitrogen annually. He concludes that there is an acute demand for all the nitrogen her fixation plants can produce.

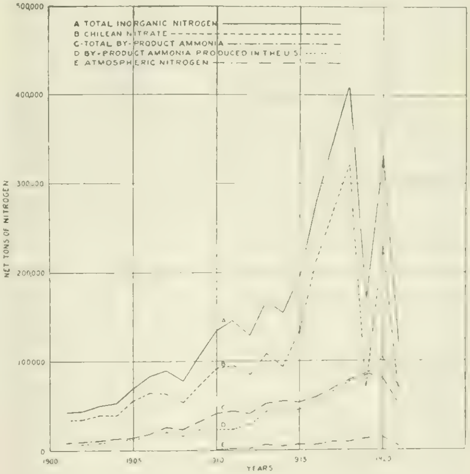
TABLE 1, NATIONAL SOURCES OF INORGANIC FIXED NITROGEN (MAXIMUM) IN 1921.
(Net tons of Nitrogen)

Countries	By-Product from Coal	Atmospheric Nitrogen Arc	Cyanamid	Haber	Total
Germany	165,000	.....	132,000	330,000	627,000
United States	127,000	300	44,000	12,800	184,100
Great Britain	110,000	.....	......	......	110,000
France	16,000	1,400	64,000	......	81,400
Norway & Sweden	......	33,000	31,000	......	64,000
Austria	11,000	.....	24,000	......	35,000
Italy	3,000	1,300	20,000	......	24,300
Canada	3,000	900	13,000	......	16,900
Switzerland	......	.....	8,000	......	8,000
Other countries	30,000	2,800	22,000	......	54,800
Total	465,000	39,700	358,000	342,800	1,205,500

Calculated from data compiled in the office of the Nitrate Division, Ordnance Department, U. S. A.

The annual consumption of inorganic nitrogen in the United States in recent years has increased at an enormous rate. Accurate statistics of consumption are not available. The amount of material available for consumption, however, is known and this differs from the amount actually consumed by the stocks carried over from year to year.

The curves in Fig. 2 show the amount of inorganic nitrogen available for consumption, as well as the amount produced in the United States for each year from 1901 to 1921. The rapid rise of the curves between 1914 and 1918 shows the enormous quantities of nitrogen used in the manufacture of military explosives. Capt. D. P. Gaillard, Nitrate Division, Ordnance Dept. estimated that the amount of nitrogen consumed in the United States in 1918, in the production of military explosives was 151,000 tons. This figure may be compared with Germany's requirement of 240,000 metric tons (265,000 net tons) under the Hindenburg program adopted August 31, 1916, as reported by Eucken. It may be accepted as an indication of the supply of inorganic nitrogen that would be required in any future war in which the United States may become involved.



Curve D in Fig. 2 shows the production of by-product ammonia, which also, with the exception of a small amount of synthetic ammonia produced in 1921, is the total production of artificial nitrogen in the United States. The area between the curves A and D, therefore, represents the nitrogen imported. The available supply of atmospheric nitrogen, represented by Curve E, consisted of cyanamid imported from Canada, and in 1921 included 1000 tons of nitrogen produced at Syracuse, New York, as synthetic ammonia.

Approximately one-half of the inorganic nitrogen consumed in the United States, at the present time, is used in the production of fertilizers. The balance is about equally divided between explosives and the chemical and other industries. The consumption in fertilizers is increasing more rapidly than the consumption for other purposes. The total nitrogen returned to the soil each year by fertilizers is a fraction only of that annually lost from land under cultivation. As the natural fertility of the soil decreases and the value of farm lands and farm products increases, there should be a corresponding increase in the demand for fertilizers. It is not unreasonable to expect that the use of fertilizer will grow more rapidly in the future than it has in the past, providing only that it is available in sufficient quantities and at a reasonable price.

---

*From a paper presented at the Atlanta, Ga., meeting, May 8-11, of the A. S. M. E.

[1] "Die Stickstoffversorgung der Welt, eine volkswirtschaftliche Untersuchung," by Walter Eucken, Stuttgart, 1921.

Assuming an increase of 10 per cent. per year, it has been estimated that the total consumption of inorganic nitrogen in the United States will be 294,500 tons in 1924 and 438,000 tons in 1930. The estimated domestic supply of by-product nitrogen from coal for the same years is 122,500 and 159,500 tons, respectively. The difference will have to be supplied by nitrogen-fixation plants and by imports.

New Jersey Chemical Society

JAMES F. NORRIS, professor of organic chemistry, Massachusetts Institute of Technology, and during the war Lieutenant Colonel in the Chemical Warfare Service, addressed the May meeting of the New Jersey Chemical Society on "Recent Developments in Organic Chemistry." Dr. Norris emphasized that one of the intangible but very real compensations of a college professor's career is the craftsman's satisfaction in his product, in which pleasure he beamed upon a goodly number of Massachusetts Tech men domiciled in New Jersey, who, it must be said, fully reciprocated the Doctor's pride in his products.

Dr. Norris submitted as a striking example of the development of organic chemical industry and the dependence of its progress upon research, the close following of the industrial research workers upon the pure science investigators and the increasing reduction of the period of application of scientific discovery to industrial procedure. The chemists' work in the war and the emergencies arising therefrom not only demonstrated the indispensability of chemical industry in a well-ordered economic system but enforced an appreciation of the status of the scientific investigator which can not fail to impart great impetus to industrial development in the organic chemical field.

On Saturday, May 6th, many members of the Society visited the plant of McNab & Harlin Mfg. Co. at Paterson, N. J., and had luncheon at the Chamber of Commerce where the Secretary, John J. Fitzgerald, spoke on "The Industries of Paterson." Mr. Fitzgerald stated that despite the industrial depression the 843 silk concerns of Paterson employing 25-35,000 people, had suffered no let-down in production and that bank deposits had increased $2,000,000. After luncheon the party visited the Passaic falls and inspected the hydro-electric plant.

The visit to the plant of the McNab & Harlin Mfg. Co. was made possible by Ernest G. Jarvis, its superintendent of foundries, who is a member of the board of governors of the New Jersey Chemical Society, to whose interest in providing a valuable industrial educational study and to the courtesies of his Company, the Society is greatly indebted. The Company which has a history of 70 years has been manufacturing valves and fittings in Paterson since 1872. The plant employs an area of 15 acres of floor space and is one of the largest consumers of electric power in New Jersey.

The visitors were taken first to the brass foundry where they saw all types of melting practice including coal and coke melting and Pitt, Schwartz & Rockwell oil melting furnaces, also two General Electric melting furnaces, one with a capacity of 1 ton per heat and the other 1½ tons per hour. These furnaces are of the modified reflecting arc type, with automatic control electrode feeding devices. These furnaces were operated at 2000° F. and are used principally on the melting of aterite. All the moulding machines were operating, affording an idea of how the different castings are made. Aterite is an alloy developed in the research laboratories of the Company about six years ago, and like many other products of research, hundreds of uses were found for it over night; today it is in use all over the world.

From the foundry the cleaning and sorting room was visited where opportunity was had to see the myriads of small parts being ground, sandblasted and sorted, prior to being shipped to the finishing departments. In the tapping department high-speed automatic machines threaded and tapped fittings. In the cock department different operations in the manufacture of cocks were seen. In the small and large valve departments the course of manufacture and assembling was observed; thus the complete process from raw material to the finished product was shown in every detail of manufacture. The manufacture of iron valves and fittings also was inspected. A very interesting demonstration of rolling sheet metal and the drawing of rod stock was shown in the rolling mill. The laboratory, where research work is conducted on a large scale in the corrosion and decay of metals, was visited, where were seen a small rolling mill and a Hoskins-type electric furnace.

The last meeting of the New Jersey Chemical Society for the year 1921-22 will be held at Princeton University on May 20th when the visiting members will be the guests of the Princeton Chemical Club.

The Mathieson Alkali Works, Inc., 25 West 43d St., New York, have acquired the plant and business of the Commonwealth Chemical Co., Newark, N. J., whose products will be continued under the new management. The Mathieson Co. already owned $100,000 of the preferred stock and the majority of the common stock.

* * *

The action now being prosecuted in the New York Supreme Court, 1st district, by George T. Rogers, Plainfield, N. J., against Joseph H. Adams and the Texas Co., involves the ownership of a 40 per cent interest in the Adams patent for recovering gasoline from petroleum, used extensively in petroleum refining.

The Standard Oil Co. of New Jersey long since acquired from Rogers the right to use the invention up to the measure of efficiency then developed. In March and November, 1918, Adams so improved his process as to increase the yield of gasoline 15 per cent. Rogers alleges that Adams in violation of his contract of 1907 sold to the Texas Co. the improvements now claimed by his assignees for the past two years the Standard Oil Co.'s of New Jersey and Indiana have paid royalties to the Texas Co., 40 per cent of which the former Company maintains belongs to it by right of its purchase of the patent rights from Rogers.

Food Research Institute of Stanford University

THE Food Research Institute of Stanford University was founded in February, 1921, by the Carnegie Corporation of New York in conjunction with the Trustees of Leland Stanford Junior University, California. It is organized for the purpose of intensive scientific study of the problems of the production, distribution, and consumption of food. The Institute grew out of a suggestion offered by Herbert Hoover, and its location at Stanford University was due partly to the fact that this university possesses, in the Hoover War Library, a large and unique collection of documentary material relating to the food problems and other economic aspects of the Great War. The Carnegie Corporation guarantees stated funds for the work for a period of ten years. Stanford University provides quarters and facilities and has appointed the directors of the Institute to positions on the Stanford faculty.

A Creation of War Experience

The founding of the Food Research Institute is an outgrowth of war experience. During the late war, possibly for the first time in history, food production and distribution, nutrition and dietetics had to be considered by governments as national and even international problems. In determining policies required to meet the emergency, food administrators sought certain scientific information, from agriculturists, economists, physiologists, and physicians. Many valuable data were readily furnished. On the other hand, much of the desired information was not in existence, not because, given time, it would have been difficult to obtain, but because no one before the war had asked these questions or attempted to reach an adequate answer. Nutrition and dietetics had been studied mainly as individual problems, not as mass problems. The food supply had seldom been examined with adequate reference to its international aspects and to the particular commodities entering into it. Marketing problems had received mainly local investigation. There had been little coordination of studies in several important fields, and serious gaps were numerous. In many instances, therefore, the lack of essential information led to action more or less in the dark.

The founders of the Food Research Institute were convinced that the scientific study of such problems, from a broad national and international viewpoint, was important in peace no less than in war. While recognizing the essential services which reasearch work in federal and state agricultural departments and colleges had rendered and will continue to render, they considered that a non-governmental organization with university affiliations could have advantages in attacking certain kinds of problems without the limitations which apply to these agencies.

Administration

The control of its policies and the active direction of the work of the Institute are entrusted to three joint directors. The plan of the founders called for the selection of an expert in agriculture and food manufacture, an expert in economics and food distribution, and an expert in the physiology and chemistry of nutrition. In accordance with this plan, the following directors were appointed in April, 1921: Carl L. Alsberg, M.D.; Joseph S. Davis, Ph.D.; and Alonzo E. Taylor, M.D. At the same time an Advisory Committee was appointed comprising the presidents of Carnegie Corporation and Stanford University, ex-officio, and the following additional members: Hon. Herbert Hoover, Secretary of Commerce; Dr. James C. Merriam, President of the Carnegie Institution of Washington; Mr. Julius Barnes, formerly President of the U. S. Grain Corporation; Dr. William M. Jardine, President of the Kansas State Agricultural College; Mr. J. R. Howard, President of the American Farms Bureau Federation; and Mr. George Roeding, formerly of the California Horticultural Commission.

The Institute Program

The Institute proposes to investigate significant food problems from the standpoint of their bearing upon national economy and well-being, to deal with them as mass problems, and to emphasize the commodity and international aspects. While it will frequently study data of individual businesses, it will do this not in order to serve as a business adviser, but primarily in order to discover principles of general importance.

The precise program of the Institute will be developed gradually. Its exact form will be determined partly by the readiness with which essential data on particular subjects can be assembled, and by the work which is already in progress elsewhere. In the course of its activity the Institute will concern itself with such subjects as the food elements in actual and normal standards of living, and the physiological and social aspects of sub-nutrition; the sources, production, marketing, and utilization of important staple foodstuffs, such as wheat; the financing of farm operations and the manufacture and marketing of food products; the analysis of important food industries and the problems which they present; the technology of food manufacture, and the desirable scope of public control thereof; and the elements in a sound national policy with respect to food production, internal distribution, and international trade.

Cooperation Without Duplication

Numerous existing organizations are already conducting research into food problems, from one angle or another, notably the Department of Agriculture, state bureaus of markets, agricultural colleges and experiment stations; research organizations of banks, business houses, trade and marketing associations, and university departments, committees, or individuals.

It will be the policy of the Institute to avoid, so far as possible, any serious overlapping of the work of established research organizations, public or private. It will endeavor rather to enlist the aid of existing organizations in the prosecution of researches in which there is a common interest, in which essential data are already collected or in process of collection, or in which another organization is in a better position to perform a portion of the research. Moreover, in numerous instances the Institute will consider its purpose accomplished if methods which it may develop, or sample studies which it may make, can be utilized by public or private agencies in undertaking similar investigations on a far more extended scale.

Locus of Work

The research work will be done, for the most part, at Stanford University. In general, subjects for investigation will be selected which do not necessitate extensive field work, or in which the results of field investigations conducted by other competent organizations can be utilized. It is recognized, however, that certain investigations which the Institute can undertake will require more or less field work by the directors, fellows, or assistants, and for these necessary provision will be made.

The Institute is organized as an integral part of Stanford University, with the status of a department for the purpose of directing research and recommending degrees. For the year 1922-23 it has established four fellowships for graduate study in the field of food research. The directors will guide the work of these fellows, and occasionally a few other well-qualified graduate students, in studies which fall within the scope outlined above and which will frequently constitute a specific part of a piece of research which the Institute has in process. Such individual research will ordinarily form a part of the work toward a higher degree at Stanford University, and will be supplemented by such work in other departments of the University as may be necessary to fulfill the usual requirements for degrees.

While the Institute does not contemplate undertaking extensive experimental work on its own account, the University's established facilities for experimental research on foods, nutrition, etc., are available to graduate students, and to a limited extent the directors of the Institute will co-operate in the direction of research in these fields. In addition, the directors will occasionally offer courses of instruction in other departments of the University.

Dissemination of Results

In part the results of researches will be published through established technical journals. Where circumstances render this undesirable, the results will usually appear in a series of publications to be issued by the Food Research Institute. In cases where certain lines of research are of interest to specific groups of readers, other or additional channels of publication will be sought in order to reach those concerned.

The first year of the Institute has been largely occupied with the establishment at Stanford, the determination of general policies, the organization of a small staff, enlarging the collection of data which will be required for research, and making certain preliminary surveys and investigations designed to furnish the basis for more intensive studies. The work will be fully under way by the autumn of 1922.

Chemists, Dividends and the Eastman Kodak Co.

The Eastman Kodak Co. is unique in chemical enterprise. The originality and vision of its founder, his appreciation of the cooperation of the industrial scientist whose work has been the cornerstone of a commercial success whose structure grew with the times, and the generous recognition of the scientific basis of his business as shown in his benefactions to educational institutions, make the Eastman organization a standard example of what science can do for industry.

In the service of this organization to popular education it follows closely upon the impetus to social development imparted by a cheap illuminant, and rivals the influence of a volatile fuel from the same source in making life all the time more worth the living.

In the eighteen and one-half year period ending December 31, 1921, the Eastman Kodak Co. earned total net profits of $212,184,685; it paid $133,014,564 in preferred and common dividends and added $5,200,000 to reserves and $73,920,121 to surplus. This latter figure totaled $370 a share on the former basis of shares of $100 par value to the number of 250,000, which recently were changed to 2,500,000 of no par value.

Taking 1-10 of the former rate as the regular dividend rate on the new Eastman shares, or $4, the yield is about 5.19% at the current level around 77. The following table of Eastman Kodak Co. earnings for the past ten years is an exhibit of one of the financial byproducts of the current intensive development of American civilization in which the chemist has played a stellar role:

Year		Net profits	Preferred dividends	Common dividends	Surplus	[illegible]
1921		[illegible]	369,942	[illegible]	[illegible]	[illegible]
1920		[illegible]	369,942	[illegible]	[illegible]	[illegible]
1919	......	18,326,188	369,942	7,819,110	10,137,136	91.8
1918	......	14,051,969	369,942	8,792,280	4,889,747	70.0
1917	......	14,542,567	369,942	5,861,520	8,311,105	72.5
1916	......	17,289,206	369,942	13,674,635	3,244,629	86.7
1915	......	15,741,453	369,942	11,719,680	3,651,831	78.8
1914	......	11,313,012	369,942	5,849,840	5,083,230	56.1
1913	......	14,162,436	369,942	7,810,620	5,981,874	70.6
1912	......	13,999,047	369,942	7,807,958	5,821,148	69.8

Year Book Canadian Institute of Chemistry

We have received from the office of the Canadian Institute of Chemistry, 392 Guy St., Montreal, Canada, a copy of the year book, 1921, of the Canadian professional organization of chemists. Modest in its 56 pages cloth-bound in blue, it is a portent of the possibilities for good to chemists that lie in the field in which this organization has the distinction to be the pioneer and precedent in North America.

Embellished by a portrait of Prof. J. Watson Bain, University of Toronto, the first president, the book comprises a statement of officers, members of the council and committees, together with a history of the Institute, its constitution and by-laws and a list of members by classes and geographical distribution.

The following list comprises members of the Canadian Institute of Chemistry resident in the United States:

H. A. BAKER, F. C. I. C., John Tarleton Agricultural College, Dept. of Chemistry, Stephenville, Texas.
C. J. BROCKBANK, F. C. I. C., 280 Summit Ave., Buffalo.
W. S. CHASE, A. C. I. C., 7517 Franklin Ave., Cleveland, Ohio.
H. J. M. CREIGHTON, F. C. I. C., Swarthmore College, Swarthmore, Pa.
J. A. DeCEW, F. C. I. C., 501 Fifth Ave., Room 1108, New York.
E. I. FULMER, F. C. I. C., Dept. of Chemistry, Iowa State College, Ames, Iowa.
I. GRAGEROFF, F. C. I. C., 224 Black Bldg., Los Angeles, Cal.
S. J. LLOYD. F. C. I. C., The University, Alabama.
J. P. STRACHAN, F. C. I. C., The Carbrox Co., Inc., North Scott & [illegible] Sts., New Orleans, La.
B. FEUER, F. C. I. C., 2634 Argyle St., Chicago, Ill.
H. B. VICKERY, F. C. I. C., Dept. of Chemistry, Graduate School, Yale University, New Haven, Conn.
[illegible] W. HANCOCK, F. C. I. C., c/o Commercial Solvents Corpn., Terre Haute, Ind.
N. A. CLARK, F. C. I. C., Dept. of Chemistry, Iowa State College, Ames, Iowa.
B. C. LAMBLE, F. C. I. C., 8306 Ferndale Ave., Detroit, Mich.
T. FRENCH, F. C. I. C., 363 Edgecombe Ave., Washington Heights, N. Y.
R. WOODHEAD, F. C. I. C., c/o The Hummel Ross Fibre Corpn., Hopewell, Va.

The movement in the United States to form a similar organization in the American Institute of Chemistry is gathering impetus with such rapidity that the national American professional organization of chemists may be expected within the present year. It is reasonable to anticipate cordial cooperation with its progenitor, the Canadian Institute of Chemistry.

Relation of Employer and Employee As Regards Ownership of Patents

By Maurice Block

Member of the New York Bar

A MISCONCEPTION seems to exist as to the legal rights of employer and employee as regards inventions made by the employee during the course of his employment. In the chemical trade this question often arises, as factory employees frequently improve the processes on which they are working, as well as the machinery used in connection therewith.

Many employers believe that all inventions or improvements made or developed by an employee in the course of the latter's employment belong as a matter of right to the employer; on the other hand, the situation may warrant the employee to maintain that such inventions and improvements belong to him, free from any rights or claims by the employer. Neither generality covers the ground. Each case depends upon its own facts. For instance, if a person is employed and paid for the express and special purpose of developing and improving a certain process, or the machinery relating thereto, then of course the thing which he is paid to produce belongs to the employer, this being a contractual relation to which the general law of contracts is applicable.

There are other cases where, for instance, no contract exists, in which the employer claims ownership of a patent obtained by an ordinary employee, on the ground that the improvement covered by it was perfected and developed in the employer's factory during working hours and with factory tools and apparatus. In such cases the courts have held the employer to be entitled to a personal license or shopright to continue to use the invention covered by the patent; but the patent itself belongs to the employee-inventor.

Precedents

Various aspects of these questions have been before the courts in numerous cases, a few of which I will summarize. The fact that the invention was made and the drawings prepared outside the hours and the shops of the employer, so long as the invention was reduced to practice and made in the employer's shops by the employee and with his consent, does not secure him the right to damages for infringement by his employer. Gill v. U. S. 160 U. S. 426; 40 L. Ed. 480; 16 S. Ct. 322.

An employee paid by salary or wages, who devises an important method of doing his work, using the property or labor of his employer to put his invention into practical form, and assenting to the use of such improvements by his employer, cannot, by taking out a patent upon such invention, recover a royalty or other compensation for such use. Gill v. U. S. 160 U. S. 426; 40 L. Ed. 480; 16 S. Ct. 322.

Complainant was employed as an expert machinist to devise and construct an improved machine and to direct the making of patterns for the same for machines to be made and sold. Later, complainant obtained a patent, and after ten years brought suit. Held: Upon this state of facts, we conclude that the appellee must be presumed to have granted to appellant's licensor a personal license to make and sell machines embodying the improvements covered by his patent. Withington v. Kinney, 68 Fed. 500; 15 C. C. A. 531.

The case is, therefore, of an inventor, who, as a workman in the employ of another, manufactures for him, in his shop, and with his materials, and upon weekly wages, machines which the employer uses as a part of his tools, without knowledge of any objection thereto, and for which the inventor during the term of his employment, obtains a patent and thereafter seeks to restrain the employer from the use of the particular machine or machines which had been thus made in the employer's shop, under the supervision of the employee, and apparently as a part of his ordinary mechanical work. On the authority of Gill v. U. S., 160 U. S. 426, the employee-patentee was estopped. Blauvelt v. Interior, 80 Fed. 906; 26 C. C. A. 243.

In the absence of evidence of an agreement that the employer should have any interest in any patentable improvement which the employee might make during the period of his employment, it would seem that the title to the invention made or to any patent subsequently obtained by him, would be unaffected by the fact of his service and in the use of his employer's shop, materials and the service of his employees while devising and perfecting his invention. Withington v. Kinney, 68 Fed. 500; 15 C. C. A. 531.

The inventor, while in the employ of the defendant made his invention and perfected the same with the tools and while under pay of defendants, and in his shops. Defendant increased the inventor's wages by reason of such invention. The invention was put in practice by plaintiff in defendant's shops and used without any agreement or license. Subsequently the inventor quit from another cause and this suit was brought. Held: That such employment and conduct gave the employer a shop right to said invention. McClurg v. Kingsland, 1 How. 202; 11 L. Ed. 102. Note: This leading case has generally been construed too broadly. The court did not hold in express terms that the mere employment or the extra pay constituted the license, independent of the subsequent conduct. This case is good for what it holds, but it by no means establishes the relations of employer and employee definitely.

A manufacturing corporation which has employed a skilled workman, for a stated compensation, to take charge of its works, and to devote his time and services to devising and making improvements in articles there manufactured, is not entitled to a conveyance of patents obtained for inventions made by him while so employed, in the absence of express agreement to that effect. Dalzell v Dueber, 149 U. S. 315; 37 L. Ed. 749; 13 S. Ct. 886; Hapgood v. Hewitt, 119 U. S. 226.

Implied License

The duration and scope of a license must depend upon the nature of the invention and the circumstances out of which an implied license is presumed, and both must at least depend upon the intention of the parties Withington v. Kinney, 68 Fed. 500; 15 C. C. A. 531; Rob. Pat. secs. 808-811; Montross v. Mabie, 30 Fed. 237.

According to the rule in Mfg. Co. v. Kinney, 68 Fed. 500, an implied license, if it relates to an improvement in the process, ordinarily authorizes the employer to continue to practice the process during the whole period of the patent. This follows because the subject matter is indivisible; but, if the invention pertains to a machine, it is understood, ordinarily, that only the specific machine or machines which have been set up during the time of the employment are protected. Such is the ordinary rule, and it is plainly based on a sound discretion. It is, of course, more a rule for the application of facts than a rule of law, and therefore is not rigid. When the patented matter is a product, particularly if it is a minor product, or even if it is a minor machine, so that in either case it is used in quantity, like the stop-valve in Lane v. Locke, 150 U. S. 193, its unlimited use during the time of employment may raise an implication of facts in favor of a license for a time likewise unlimited, as in the case of a process. Boston v. Allen, 91 Fed. 248; 33 C. C. A. 485.

An employee, salesman of defendant envelope manufacturer, having induced him to manufacture and sell the envelope which the employee had invented without putting any limitations on the employer's rights, it was held that the employer-manufacturer was given an implied license to make and sell to his customers, and an assignee of the patent with notice of the facts took subject to such implied license. Mix v. National Envelope Co., 244 F. 822.

Ownership

Whether a patent for an invention made by an employee belongs to him or the employer depends upon his position. If the work for which he is paid is done under direction of others, any invention he makes outside of such work is his own; but if the patentee is not a mere employee but has the main responsibility to make the business successful and if in substance he contracts to devote his time and services to making improvements in articles made by the company with which he is connected, a patent for any such improvement belongs in equity to such company. Dowse v. Federal Rubber Co., 254 F. 308.

An employer has no right to the patent for an invention made by an employee in the absence of an express contract or agreement of a specific employment to make the invention; apart from such express contract, and upon the mere general relation of employer and employee and of the facts and circumstances attending it, an employer is vested with nothing other than a shopright, or irrevocable license to use the patented invention. Such a right in the employer the employee may be estopped to deny by the fact of his employment and his conduct in relation to the use of his invention by his employer and to that extent and no further have the cases gone. Pressed Steel Car Co. v. Hansen, 137 F. 403 (3rd Cir. 1905).

Complainant, while in the employ of a manufacturing corporation as its chief engineer, charged especially with the duty of developing its business and keeping its products abreast of the times, designed a number of improved devices in connection therewith, which were patented in his name, but at the sole expense of the corporation which used the inventions in connection with its manufacture for several years without payment or claim for royalties. Held that while the employee held the legal and beneficial title to the patents as against others, the corporation was entitled to a right in and an indefeasible license to use the patented inventions as against the employee and his assignees, and that, on a sale of the stock of the corporation, a new corporation, organized by the purchasers, which took over all its property and business, succeeded to such right and license. Wilson v. J. G. Wilson Corp., 241 F. 494.

Institution of Chemical Engineers

The formation of the English Institution of Chemical Engineers, 14 years after the establishment of the American Institute of Chemical Engineers, organized in 1908, has followed the general lines of segregation of the latter society. The Chemical Engineering Group of the Society of Chemical Industry is an educational body and not adapted to the extension of its functions to the promotion and protection of the economic interests of the members of this hybrid profession of chemistry and mechanics.

Activity on the part of the older engineering groups in English industry in demanding recognition in a way that disregarded the interests of chemical engineers has encouraged the formation of the English prototype of our own successful American Institute of Chemical Engineers. The work of the organization committee came to a head on May 2, at Hotel Cecil, London, when at the inaugural meeting presided over by Sir Arthur Duckham, K. C. B., constitution and by-laws were adopted and the machinery of the English professional organization of chemical engineers was set in motion.

Encouragement of the growth of the English Institution and assurance of affiliation with the American Institute, were expressed in a letter by Henry Howard, president, American Institute of Chemical Engineers, which contained the following proposals:

> The American Institute would print, in its Year Book, the names and addresses of all the members of the English Institution, and the English Institution on its side would print, in its Year Book, the names and addresses of the members of the American Institute. This would be of use to English and American members when visiting the United States and England respectively.
>
> All members in good standing in the English Institution should have all the privileges of regular members of the American Institute, except voting, at the meetings of the American Institute. This would include participation in sessions at which papers are read, and visiting such industries as may be on the programme. The same privileges would, of course, be extended by the English Institution to members of the American Institute visiting England.
>
> One copy of all bulletins and publications to be sent by the Secretary of each Institute to the Secretary of the other, who, in turn, can transmit such information as he thinks will be of interest to the members of his own organization. By this means members of each Institute will be kept posted as to the activities contemplated by the other and perhaps arrange their plans so that they can participate if they are called upon to visit England or the United States as the case may be.
>
> The copies of the transactions of each Institute are to be available to all members of the other Institution at cost price.

American industrial chemists cannot look with indifference upon the development of economic segregational activity in every branch of applied chemistry save that which concerns their own immediate welfare. The precedents of English history will not be lost upon American chemists with capacity of leadership and instinct of service.

If English chemists and chemical engineers, in final recognition of the futility of a scientific, educational society functioning satisfactorily as an economic professional body in the promotion of the material interests of its members, organize respectively the Institute of Chemistry of Great Britain and the Institution of Chemical Engineers, the logical step to complete the system in America is the recognition of the American Institute of Chemistry.

C. L. Bryden, 381 Fourth Ave., New York, has been appointed eastern representative of the Chemical Equipment Co., Chicago, Ill.

II. Biscuit and Cake Manufacture

Influence on Finished Products of Several Ingredients with Especial Reference to the Action of Milk

By Washington Platt, Ph.B., M.A.

Production Manager, Harris Laboratories, Tuckahoe, N. Y.

THE preceding article* was concerned with the raw materials of biscuit and cake manufacture and the influence of the ingredients upon the finished products, which covered sweetened and unsweetened biscuits. In the present and concluding article will be considered other products and the influence thereon of the several ingredients, with especial reference to the action of milk.

Drop Cakes

The method of making drop cakes is quite different from that of making biscuit and the effects of the ingredients on the finished product are, therefore, often correspondingly different. The dough in the case of drop cakes is in the form of a liquid batter which must be beaten up in a mixer running at comparatively high speed; i.e., from 40-100 revolutions per minute. The mixtures are always richer in sugar, and generally in shortening, than biscuit mixtures. Medium formulas contain about 50 lbs. of shortening and 140 lbs. of sugar to the barrel; while fairly rich cakes, such as vanilla wafers, may contain 65 lbs. of shortening and 145 lbs. of sugar. Some cakes go as high as 170 lbs. of sugar to the barrel. These cakes approach taffy in appearance and taste.

The method of mixing is designed to give a light batter holding as much air as possible, and with the shortening as nearly emulsified as possible. The importance of these results becomes greater as the amount of fat used increases. It is also important to get just the right proportion of sugar dissolved in the batter, the remainder dissolving during the baking. As an example, the method of mixing a fairly rich, high-class cake such as vanilla wafer, may be taken. The formula is as follows:

1 bbl. Soft Patent Flour
40 lbs. Butter
25 lbs. Lard
130 lbs. Fine, Granul'd. Sugar
16 lbs. Invert Sugar Syrup
3 gal. Eggs
2 pts. Vanilla Extract
13½ gal. Milk
3 lbs. Soda
1 lb. Salt
1 lb. Ammonium Bicarbonate
1 lb. Calcium Acid Phosphate

Beat up the sugar, butter and lard for 15 minutes. Add the invert sugar syrup and beat 5 minutes. Add 4 gallons of milk and beat 5 minutes. Then the eggs and flavor and beat 1-2 minutes. Dissolve the ammonium bicarbonate in the rest of the milk and beat 3 minutes. Add the flour, sift in the soda, salt and acid phosphate and beat not more than 5 minutes. The resulting batter has a viscosity somewhat similar to very heavy cream.

This batter is placed in the hopper of a wire cutting machine. The batter flows by gravity through holes in the bottom of this hopper. Small portions of it are cut off as it oozes through the holes by a moving wire. These portions fall in regular order on to a greased pan which is carried below the hopper. The pans containing these small deposits of dough are then baked in a reel oven at about 430° F. for about 5 minutes. The result is a small yellowish brown drop cake about 1½ inches in diameter and ⅜ of an inch high in the center, being thinner at the edges.

Influence of Ingredients

The effects of some of the ingredients in a cake of this kind compared with the effects of the same ingredients in a biscuit may now be considered.

Shortening has the same general effect as in a biscuit. Trouble is apt to be experienced, however, on account of the large amount used. For this reason oils, such as cotton-seed oil, cannot be used in drop cake baking as well as in biscuit making, as they run out of the cake, making it greasy and causing grease spots on the paper in which it is packed. Butter, lard and lard compound have the advantage that they hold air when beaten up in these fast mixers. Oil has little air-holding power and is therefore much less desirable.

The effects of different kinds of sugar are in general similar to the effects in biscuit dough. The stickiness of the dough is of small importance in drop cakes as it does not have to go through the rolls or under a cutter. The difference between the action of sugars on the one hand and dextrose and levulose on the other hand is as marked in the case of drop cakes as it is in biscuits.

The use of eggs is much commoner in drop cakes than in biscuits, and their effect is much more important. Cakes depend for their texture entirely upon the ingredients used, rather than upon the method of handling; fine texture cannot be brought about by folding and rolling the dough into many thin layers as is often done in the case of biscuits. For this reason, eggs, which are the most efficient agent known for holding air and giving a fine, light texture, are very valuable.

In biscuit the more wetting added the softer the dough, the more steam is formed in the oven, and consequently the higher the biscuit rises on baking, and the more open the texture. With most biscuit such an effect gives a "poor" grain and is considered undesirable. In drop cakes the dough is already too liquid to spring much in the oven. It is, in fact, so soft that the first expansion in the oven is lost before the baking is completed. For this reason, contrary to the effect in biscuits, the addition of more moisture to a drop cake results in a flatter cake.

Drop cake doughs are mixed only 2-5 minutes after the flour is added. This is in sharp contrast to the 30 to 100-minute mixes given to biscuit doughs. The less a drop cake dough is mixed after the flour is added the less the gluten of the flour is developed and hence the tenderer the cake.

Pound Cake

In making pound cake the air-holding power of the shortening is utilized to the highest extent. In these cakes it is absolutely necessary that the batter should be light and full of air when the flour is added, and that the dough should likewise be light and spongy when it goes into the oven. This is particularly due to the fact that no leavens, giving an artificial supply of gas, are used in the case of pound cake, and also is due to the fact that the cakes are baked in large tins for several hours. During such a slow baking the cake rises but little, so that it must already have an open texture when it goes into the oven.

The following may be used as an example of the method of making cakes of this sort:

---

*Chemical Age, April; pp. 157-160.

105 lbs. Soft Winter Patent Flour	7 gals. Eggs
33 lbs. Butter	3 gals. Milk
16½ lbs. Lard Compound	1½ ozs. Lemon Oil
87 lbs. Pulverized Sugar	8 ozs. Vanilla Extract
	3 ozs. Mace

Beat up the sugar and butter into a light mass, for 7 minutes. Add the lard compound and continue beating. Then add the eggs, a small amount at a time, beating between additions, so that the whole mass will be light and foamy. Then add the milk in a similar manner, small portions at a time. If all of the milk is added at one time, the light batter is destroyed and a good cake cannot be made. Finally add the flour and flavoring and beat three to four minutes.

In cakes of this kind the use of shortening with a high capacity for holding air is essential. Butter or lard compound must, therefore, be used. Lard itself has very much less air-holding capacity and any oil would be entirely out of the question. The sugar also should be finely pulverized so that it can be incorporated into the shortening, giving a light mass. Syrups or molasses will not form a light mixture with shortenings. Eggs are more important than in the case of biscuits or drop cakes, as their air-holding properties are utilized to the fullest extent.

Sugar Wafer Tops

Sugar wafers are made in the form of a sandwich, the top and bottom, known together as the "tops," being a very light, thin, crisp-baked product, and the filling in the middle being usually a combination of cocoanut stearin with sugar and flavor.

The method of making the baked parts of sugar wafers, i.e., the "tops," is entirely different from anything considered above. Flour is beaten up in a fast beater with milk and water, to form an exceedingly thin batter. The usual formula is:

190 lbs. Soft Winter Pat. Flour	20 gals. Water
15 gals. Milk	2½ lbs. Soda

This batter is baked in an exceedingly thin layer between two metal plates, quite similar to a waffle iron. The plates or irons are gas-heated and the whole process is carried out automatically on machines built specially for the purpose.

A similar process is used in making ice cream cones, except that here the batter is somewhat thicker and a small amount of sugar and shortening may be added. As but little shortening is added to any of these products the tenderness and crispness depend entirely upon having a fine light structure and upon having the product perfectly dry. When properly made, sugar wafer tops resemble the texture of beaten egg whites after baking. If sugar wafer tops are exposed to the air they take up moisure, becoming pliable and tough instead of crisp. These tops come out of the baking machine in the form of thin cakes about 12 by 24 inches and ¼ of an inch thick. They are stiff and very fragile.

Influence of Ingredients

On account of the peculiar way in which these products are made, the effect of various ingredients is quite interesting. In the case of shortening, the main difficulty occurs in getting it so thoroughly emulsified in the batter that it will not separate on standing. Often very small amounts of unemulsified shortening spread out over the surface of the cake during baking causing large [illegible]. On account of the necessity for emulsion, [illegible] should always be used as shortening instead of fats. When skim milk is used the presence of some added [illegible] is absolutely essential as will be seen below.

Sugar has the effect of making the cake pliable while still hot just after baking. This property is utilized in the making of ice cream cones. Here the flat cake as it is taken hot from the irons is immediately wrapped around a wooden cone to give it the desired shape. More than a very little sugar causes the cake to stick so badly to the irons that the process becomes impossible.

Dextrose or levulose would never be used, as the object is to have the finished cake remain as dry as possible. Eggs give a satisfactory product, but are expensive and unnecessary. Very large amounts of starch can be added to batters of this kind. In fact the so-called Japanese rice cakes can be made of rice flour in place of wheat flour, rice flour being 79 per cent. of starch. The omission of all wheat flour, however, is attended with many difficulties and requires changes in the formula in order to make a cake which will hold together sufficiently for packing and transportation.

The use of soda in sugar wafer tops is the same as its use in biscuit. With soda the cakes brown evenly on the irons, whereas without soda the proper browning is impossible. The resulting product is also tougher when made without soda than when soda is used.

The Use of Milk in Baked Products

When food products were comparatively cheap and before careful analyses of costs were made in the baking business, milk was commonly used in all or nearly all forms of baked products. As prices rose and competition became keener more care was necessary in making up formulas in order to make the best possible biscuit or cake for the least money. The problem is here considered purely from a commercial standpoint. All of the biscuits were made from pure, wholesome and nutritious ingredients, but beyond this, questions of the nutritive value were not considered. The question to be studied, therefore, was in which baked products should milk be used and in which ones could the money spent on milk be more profitably expended on other ingredients such as shortening or sugar? Investigation was therefore made, bearing in mind the characteristics of the different baked products and the influence of each ingredient as outlined above.

Milk was delivered to the bakery during the night in 10-gallon cans which were kept on trucks in the ice-box until ready for use. The cans were brought up to the mixing-room from time to time as needed. After they were emptied the cans had to be washed and collected again on trucks ready for return to the producer. The use of milk thus involved a certain amount of labor and trouble, the cost of which is not included in the cost of the milk.

The milk was bought on a guarantee that it should contain not less than 3.5 per cent. of butter fat. A sample, therefore, was drawn from each can and tested by the Babcock method. Almost no trouble was experienced with the milk from low fat content, sourness, dirt, adulteration or any other cause due to poor quality. In this discussion the following average composition of milk is used:

	Per Cent	Weight per gal. in ounces.
Fat	3.6	4.95
Protein	3.6	4.95
Lactose	4.8	6.6
Ash	.7	.96

Milk in Biscuit

Milk had been used more or less at random in biscuit, its use being more common in the more expensive kinds.

To biscuit without a marked flavor, milk gave a very mild but pleasant taste. Milk also added to the color and shortness of a biscuit and gave it an attractive, glossy appearance. The question to be considered was, could these same effects be more cheaply secured by the use of extra shortening in place of milk?

The general proportions are seen from the following: In hard sweets 6 gallons of milk were used at 20 cents a gallon, which equals $1.20; these 6 gallons containing:

1.85 lbs. Butter Fat, value $0.565
1.85 lbs. Protein
2.48 lbs. Lactose

For the purpose of investigating the value of the fat, protein and lactose used in a biscuit, small experimental batches of sugar cookies were made, having a formula adapted to bring out the influence of the different ingredients. The formula used was the equivalent of the following, all of the amounts being reduced proportionately so as to make small experimental batches:

1 bbl. Soft Winter Pat. Flour	4 galls. Wetting (milk or water)
28 lbs. Cocoanut Oleine	1 lb. Soda
44 lbs. Soft "C" Sugar	1 lb. Salt
12 lbs. Corn Syrup	1 lb. Ammonium Bicarbonate
30 lbs. Invert Sugar Syrup	1 lb. Calcium Acid Phosphate

The dough was mixed in the same manner as is customary for sugar cookies of this type made on a large scale in a bakery. That is, the sugar, glucose, invert sugar, salt, wetting and shortening were mixed twenty minutes until the sugar was well dissolved and the shortening broken up and mixed with the resulting syrup. The ammonium bicarbonate was then added, dissolved in part of the wetting. Finally the flour was added with the soda and acid phosphate sifted into it. The whole was mixed 20 minutes. This mixture gave a fairly soft, pasty dough like that of a sugar cookie. The temperature of the dough after mixing was 75° F. For these experimental batches the mixing was done in a small mixer holding 5 lbs. of dough. The model is the same as the larger mixers; the arms make 16 revolutions per minute and the results obtained were very close to those obtained from mixers of the full size.

After mixing the doughs were rolled out into a thin sheet by passing between steel rollers worked by hand, the dough being carried on a canvas cloth. After rolling to the required thickness the sheet of dough was cut up by a hand-cutter into disc-shaped pieces 2 inches in diameter, after which it was baked in an electric oven for 5 minutes at 450° F.

This process of making these experimental doughs was intended to imitate as closely as possible the corresponding processes through which the full-sized dough passed in the cutting machines and ovens. The results obtained were quite comparable with those obtained on the full scale. The resulting cake was a small, light brown sugar cookie with a mildly sweet taste. The cocoanut oil was chosen as shortening in these experimental batches on account of its absence of taste, thus allowing the taste of the milk, butter fat, etc., to be distinguished when these substances were added.

After making up a batch as described above, using water as wetting, another batch was made just the same way except that 4 gallons of milk was used in place of 4 gallons of water. The resulting biscuit had a distinctly pleasanter taste than the biscuit in which only water was used. The biscuit was likewise slightly shorter. The 4 gallons of milk used contained 1.24 lbs. of butter fat, 1.24 lbs. of protein, 1.66 lbs. of lactose and .24 lbs. of ash.

Another experimental batch was then made using water as wetting, but adding 1.45 lbs. of butter, containing 1.24 lbs. of butter fat, to the mixture; this being equal to the butter fat contained in 4 gallons of milk. This biscuit seemed in every way the equal of the miscuit made with milk. It was just as short and the pleasant flavor, due to butter fat, was slightly more pronounced than in the biscuits made with milk. Further experiments confirmed the opinion that biscuits containing butter in the mixture give more of the pleasant butter flavor than biscuits made with milk containing an equivalent amount of butter fat. This would seem to show that the flavor developed in butter during the ripening of the cream and the making of the butter persists to a more or less modified extent in the baked biscuit. As this butter flavor is exceedingly desirable in biscuit not containing added flavors such as lemon oil or ginger, it would seem that highly flavored butter would be more desirable than mild butter for baking provided of course that disagreeable flavors or rancidity were excluded.

This conclusion is in accordance with the prevailing opinion among bakers, especially the older bakers who were more accustomed to the use of butter in this type of biscuit than the bakers of the present day. When a sufficient amount of high-flavored butter is used the butter flavor can be distinguished even in biscuits containing molasses, and ginger snaps. It used to be quite common in Ireland to make ginger snaps with high-flavored, local, country butter, and the results were very delicious.

Four gallons of milk cost 80c. The value of the butter fat in this milk was 1.45 lbs. of butter, containing 1.24 lbs. of butter fat, at 30½c., making 44.2c. These experiments seem to show that the benefit derived from the milk in biscuit was due entirely to the butter fat, and the above figures show that the equivalent butter is much cheaper than the milk.

Value of Lactose

In order to test the value of lactose in biscuit, experimental batches were made using pure lactose in place of the sugar in the above formula. Such batches represent as much lactose as would be contained in about 100 gallons of milk. Even when used in this exaggerated amount, however, little benefit could be noticed from the lactose in the biscuit. The lactose causes little if any sweetness.

Sucrose, as was shown above, makes the dough short, and makes the resulting cake spread and flatten out giving it a "rich" appearance. The action of lactose is totally different. Its action on the gluten is very slight and it has practically no spreading power. The resulting biscuit is, therefore, high and poor-looking with an undesirably open grain. When 1.66 lbs. of lactose was used in the regular mixture, this representing the lactose which would be contained in 4 galls. of milk, no effect could be discovered in the finished biscuit.

Conclusions

The conclusions to be drawn from these experiments are that lactose has none of the desirable qualities which sucrose has for biscuit baking; at the same time, it does no harm in the dough and has considerable food value. It adds weight to the dough and finished biscuit and might, therefore, be used as a filler if the price were low enough. To make use of lactose commercially advantageous the price would have to compare with that of corn starch which is now sometimes used as a filler in moderate amounts, rather than with the price of sucrose. Corn starch and lactose can be added in amounts up to 30 lbs. to the barrel to a biscuit mixture without necessitating any increase in the amount of sugar or shortening used to maintain the same appearance and richness of the dough and finished biscuit. If, on the contrary, flour should be used in this manner, it makes the whole mixture "poorer" so that a further addition of sugar and shortening are necessary to maintain the former quality. In this way nothing is gained by the addition of flour for this purpose.

The value of casein, lactalbumin, ash and other ingredients in milk was tested by making up experimental batches with the above formula using water as wetting and adding various amounts of skim milk powder. Little, if any, benefit could be noticed from such additions.

The general conclusion to be drawn from these experiments on the use of milk in biscuit, and similar experiments made on a large scale in the factory, is that practically the only benefit conferred by the use of milk in biscuit is due to the butter fat which the milk contains. In biscuit where it is desired to produce this butter flavor the same result can be more cheaply obtained by the use of an equivalent amount of butter fat. Where the butter flavor is not desired the equivalent shortening effect can be still more cheaply obtained by using lard in place of butter fat. The other ingredients in milk are without commercial value in biscuit making.

Use of Milk in Drop Cakes and Pound Cakes

Similar, though not so complete, experiments were tried to determine the value of milk in drop cakes. Here it was noticed that in bakery practice the use of milk was almost universal except in the cheapest cakes which contained large amounts of sugar and comparatively small amounts of shortening. Efforts were made, as before, to replace the milk by water plus an equivalent amount of butter fat. In this case, however, the results obtained were not nearly so good as when the whole milk was used. Biscuit made with milk had a more desirable texture and a "richer" appearance than those made with water plus butter fat.

Other experiments, made with water, plus lactose in various amounts, showed that, just as in biscuit, lactose has little if any effect either desirable or undesirable in drop cakes. Experiments made with drop cakes using water plus an equivalent amount of skim milk powder, gave results very nearly equal to those obtained when entirely whole milk was used. It will be seen from these experiments that, contrary to the case in biscuit making, the milk solids other than fat and lactose play an important part in the making of drop cakes. In drop cakes, as was seen above, comparatively large amounts of fat are beaten up rapidly with the wetting. Here the emulsifying power of the milk proteins is of great importance in getting the fat into the proper state and so in giving a proper texture to the finished cake. The value of the butter fat in the milk is about equivalent to the value of the same amount of butter fat obtained from butter.

Six experimental batches of pound cake were made. The old-time pound cakes commonly were made without any milk or water at all, eggs being relied upon entirely to supply the necessary moisture. Even in the modern mixtures the amount of milk used is comparatively small being about 4 galls. of milk to 7 galls. of eggs. The testimony of practical bakers was that it was impossible to make as good a pound cake with water as with milk. As fast beating together of the shortening and wetting is a feature of pound cake making, the same as of drop cake making, it seems probable that the emulsifying power of milk is here again an important factor.

Use of Milk in Sugar Wafer Tops

Attempts to make sugar wafers by the formula given above, substituting water for the milk used, were entirely unsuccessful. The wafers were course and tough, and decidedly inferior in every way to those made with milk. Attempts were next made to make a sugar wafer using water plus 11.7lbs. of skim milk powder, this being the equivalent of the solids not fat in 15 galls. of milk. The results in this case were very nearly equal to those made with entirely whole milk, showing conclusively that the ingredient of the most importance in this case is contained in the solids not fat rather than in the butter fat.

Here again, the mixing consists of a very fast beating up of a thin batter with the wetting. It seems probable, therefore, that it is the emulsifying power of the milk proteins which gives the desired results. The use of skim milk powder, in place of whole milk, did not give quite as tender a finished product. Another result of using skim milk without fat was that the batch foamed badly while mixing, the foam rising completely out of the mixer. No trouble of this sort had ever been experienced when using full milk. This trouble was entirely obviated and the quality of the sugar wafers brought up to standard by using 4½lbs. of cocoanut oleine to a batch in addition to the skim milk powder.

General Conclusions

The general conclusions to be drawn from the above experiments are:

I. In biscuit practically the only value derived from the use of milk comes from the butter fat contained. This value can be more cheaply and advantageously secured by the use of an equivalent amount of butter in place of milk. In biscuit, therefore, the use of milk is not to be recommended.

II. In drop cake and pound cake the butter fat of the milk has a value equal to the butter fat in an equivalent amount of butter. The principal and characteristic value of the milk, however, comes from its emulsifying power. This emulsifying power is so necessary in securing a good finished product that the use of milk is justified in these cakes.

III. In sugar wafer tops the emulsifying power of the milk is absolutely essential for the manufacture of good sugar wafers. The butter fat of the milk can be replaced by other oils if desired.

U. S. Dryer & Machinery Co., capital $150,000, York, Pa., is a new incorporation to engage in the manufacture of double-shell dryers. Wm. J. Kuntz, formerly general manager and treasurer, Ruggles-Cole Engineering Co., New York City, is the general manager of the company. Mr. Kuntz for many years was vice-president and general manager of the Steacy-Schmidt Mfg. Co., York, Pa., in whose plant the Ruggles-Cole dryers were made. The U. S. Dryer & Machinery Co. has acquired the plants of the York Bridge Co. and Cochrane Brass Foundry, York, Pa., embracing an 11-acre tract with buildings well adapted to the purposes of the new company.

Geographical Aspects of the Electrochemical Industry

By Walter S. Landis

Chief Technologist, American Cyanamid Company; Past President, American Electrochemical Society

THE electric current furnishes two important tools to the chemist, viz., (1) a convenient source of heat and (2) a powerful chemical decomposing effect. As a source of heat in the chemical industry, the application of the current ranges from the small hot-plate of the laboratory to the 20,000 horsepower carbide or ferro-alloy furnace. Unlike the ordinary production of heat through combustion, there is no necessity of air supply, and there are no gaseous or solid products to be disposed of. Ashes, dust and clinkers are absent; there is no oil, grease, air or steam to contend with.*

Electric Heat

Through suitable control of the two factors of current and resistance, heat may be produced in any desired quantity, at any desired temperature, at any desired place and at extremes of temperature varying from that of the warming pad to the graphite furnace. In fact, there seems to be no definite upper limit of temperature, for the electric current has no bulk, and concentration of energy, which determines temperature, may be made what is practicably desirable.

Direct comparison of the cost of electric heat with combustion heat in general is a difficult matter; in specific cases it may be comparatively simple. Many factors apply in such comparison, the most important one being the ready applicability of electrically generated heat. It may be released in intimate contact with the absorber, at rates balanced against rates of absorption and in any desired atmosphere. It frequently is generated within the absorbing medium itself. Automatic temperature control is simple and effective, regulating the supply to the demand. It permits the attainment of high temperatures on a scale unknown to the combustion engineer. These factors should be taken into account.

Combustion Heat

The combustion of a ton of high-grade bituminous coal yields approximately the same number of heat units as a kilowatt year of electricity. In the combustion of coal air must be introduced, and flue gases are produced which without elaborate regenerative systems carry away a large portion of the heat generated. The careless admission of air emphasizes this loss. Incomplete combustion is not unknown in practice. The large combustion chambers require increased radiation losses. At the higher temperatures all these effects are very greatly emphasized.

The steam generating unit possesses all the direct faults of the combustion process enumerated, plus the inefficiency of the prime mover itself. Modern steam-power plants operating large units convert potential energy of coal into electrical energy at thermal efficiencies approximating 20 per cent. Many heating, melting and refining furnaces do not use their fuel so efficiently. This relationship coupled with the highly efficient conversion of electrical energy into usefully applied heat does not in any sense exclude the steam-electric combination as a competitor of direct firing, and there are many other advantages to help pay the heavy overhead.

Displacement of Coal

Different relationships exist in different parts of the world. In Italy, in those parts favored with water-power developments, the kilowatt year is produced rather cheaply; many installations have found it cheaper to generate steam by submerging the resistor in a boiler, than to burn the expensive imported coal.

Norway, like Italy, has no coal. She has abundant hydraulically generated power averaging less than $12 per kilowatt year. Naturally the electric heater of every type has nearly supplanted the old stove and furnace. A plan actually has been worked out in Bergen for heating houses from central hot-water storage plants, the water being electrically heated.

The sole domestic metallurgical fuel of Sweden is charcoal, which is becoming scarcer and consequently higher-priced each year. In the manufacture of pig iron in the blast furnace, approximately 1 ton of charcoal is required for a ton of pig iron produced. Of this, 1/3 is used in chemical reduction of the iron ore and 2/3 is burned up by the blast to supply heat of operating the furnace. Now, 1/4 of a kilowatt year per ton of pig iron will suffice to keep the furnace hot, and when the cost of charcoal rose to the point where a ton of charcoal cost more than 3/8 of a kilowatt year, which it did some ten years ago, the old blast furnaces were supplanted by electric furnaces. In other words, when the kilowatt year can be bought for the same price as 2½ tons of charcoal or coke, the blast furnace becomes obsolete. Norway, Italy, Sweden and Japan have made the change, and India, Brazil and our own Pacific States are contemplating the adoption of the electric furnace in the iron industry.

It must not be inferred from the above example that electric energy can supplant fuel only where the former is very cheap or the latter is very dear. The dividing line is not so far apart as is ordinarily believed. With electric energy at 1c per kilowatt hour or approximately $65 per horse power year, coal would be cheaper at around $50 per ton for low temperature work, on heat unit basis alone, but at working temperatures above 1400° C. the coal could not cost more than $10 per ton. At higher temperatures the coal would have to be still cheaper. At the same working temperature of 1400° C. fuel oil could not cost more than 6 or 7c per gallon.

City gas at $1.25 per thousand cubic feet would be more expensive than the 1c per kilowatt hour electricity for operations at any temperature. These are all outside figures and many specific cases would show electricity to even better advantage. The field of carbide, ferro-alloys, graphite, abrasives and like high temperature operations would be impossible without the use of electric current irrespective of the relative costs of the two sources of heat.

Cost of Electrical Energy

As regards the costs of electric power, Norway and Sweden possess many possible hydro-electric developments that could furnish power at $10-$12 per horsepower year (1/6 to 1/5c per KWH) and some of the older developments, now partly amortized, sell at even lower figures. Italy could sell at nearly the same prices. Canadian Niagara power has been sold in the vicinity of the power house stations as low as $10, to large users. Niagara power in the states is governed by regulation and sells in blocks at $18 per horsepower (3/10c per KWH). Some of the Pacific Coast powers could be developed and sold at about the same price as the Niagara power on this side of the border. Our southern powers are more expensive because of the wide fluctuations in stream flow throughout the year, and would average nearly $25 per horsepower year (4/10c per KWH). All these costs are less than half the assumed value in our example above, and would assist greatly.

---

*From paper presented at joint meeting, March 21, of the Cleveland sections of the American Institute of Electrical Engineers and the American Chemical Society.

Transmission costs could hardly be expressed in a simple manner and still be exact, but I do not believe I would affront many principles of commercial economics if I assumed a transmission cost of approximately $5.00 per horsepower year per hundred miles, for large transmission lines fully loaded. In other words, if we could eliminate petty jealousies, regulation and other hindrances, Niagara power should be sold in Cleveland in large blocks at about $25 per horsepower year, or less than half our assumed cost in the comparison example above. At such price it should compete with coal in Cleveland for most heating purposes requiring temperatures exceeding about 1,000° C., thermal values alone being considered.

Reference to statistics showing the quantities of power used, in terms of kilowatt hour per unit of product, in the various more highly developed electro-thermal industries, discloses that the cost of power varies from a few per cent. up to a maximum of 25 per cent. of the market value of the product itself. Because of the comparatively low percentage which power cost bears to market prices, an adverse rail-basing point, a poor labor market, remote raw materials and other related conditions readily could counteract an apparently low power rate. In turn, these disadvantages might be eliminated within a moderate transmission distance.

I recall several large electro-chemical industries actually conducting their operations at a material disadvantage because they over-estimated the advantage of cheap power obtained through location close to the generating station. In one case, poor railway facilities and remoteness from a good rate-basing point have added to the cost of the product the equivalent of nearly the actual power cost. The added freight costs alone would have transmitted the power used a long distance. The electrical engineer has changed greatly the early set ideas of relative location of generating station to chemical plant, and is not through yet. Unfortunately our plants are not portable.

Load Factor of Steam Plants

The importance of power cost to the electro-chemist warrants further consideration of the steam plant and its possibilities. The average steam station on public service load rarely has a very high power factor, and much of the equipment is idle a great part of the day. Even where intensive drives have been made for off-peak loads, it is unusual to find a load factor of above 50 per cent. In other words, each unit of power delivered to the consumer must carry a fixed charge and overhead practically doubled because of irregular load.

On the other hand, the electro-chemical industry as a rule offers a 24-power load. In the industry with which I am identified, the load factor is determined on the monthly period as an average of about [illegible] per cent. Steam plants operating on such full load basis require close consideration, and coal fields must possess relatively equal possibilities with remote hydro-electric developments. Scores of electric melting and refining furnaces operate on steam power.

The public service power plant frequently has tried to incresase the interest of the electrochemist in off-peak power, but not much progress has been made in getting the two groups together in the lines of our greatest development. This, however, should not be taken as a criterion that steam power is excluded entirely from our field. Central Europe with its lack of hydro-electric power never has been backward in its electro-chemical development. A super-steam plant advantageously located and delivering an electro-chemical load might transmit a long distance and sell at a profit of 1c. per kilowatt hour.

Electrochemical Requirements of Power

As regards the electrochemical requirements of power, the average reactions require but a few volts. I do not recall any needing more than six volts, and even after allowing for the drop due to resistance the electrochemist demands only very little tension currents. This emphasizes the power of the electric current as a chemical tool. However, were I not to add that it requires a great deal of skill properly to use it, I should be telling but half the story.

On the other hand, electrochemical operations require a high amperage for performing a definite amount of work. For example, 1,000 ampere hours will plate out only 2½ pounds of copper from the usual sulphate plating bath, or will produce about ½ pound of aluminum in an aluminum pot. But even under such circumstances steam power is not excluded from use. Storage batteries are still being made in Philadelphia. Even caustic soda, a notorious power consumer, has been operated on steam power. In the industries represented by copper, aluminum, lead, zinc, silver, gold, caustic soda, storage batteries, pharmaceuticals, intermediates, plating of all kinds, we are much more restricted in our range of location than we are in the heavier industries that could make use of the electric current.

With this cursory outline of the general applications of electricity to chemistry, the relations of the current to other requirements of the processes and the relative value of the power to the total costs, we are in a fair position to survey the geography of our field of activity. The mere fact that low-cost electric power exists somewhere does not always make it cheap. Raw materials, labor and transportation often are more important factors than electric energy.

Geography of Electrochemical Industry

Norway. Norway possesses cheap power. She has little else in the way of raw materials and must import supplies. Her labor is scarce, fairly high-priced and of uncertain temperament. She has built up a great nitrogen industry using only air, water and electricity and holds a practical monopoly of this type of process. The carbide and cyanamid processes have failed for several reasons, chiefly because of high cost of imported coal and coke and long hauls on limestone. Her aluminum industry is undergoing a change with the hope of being able to utilize a local feldspar instead of the usual French ores. Her steel industry has remained small.

Sweden. Sweden has an electric iron and steel industry of fair proportions but is handicapped by lack of fuel. Swedish ores will continue to be exported in the face of available electric power for home manufacture.

Germany. Germany has developed a considerable electro-chemical industry in spite of very limited hydro-power. Brown coal efficiently burned under boilers is operating melting furnaces, caustic and cyanamid plants, steel furnaces and other electrochemical processes. She is quite a factor in this industry, certainly leading Europe, and yet has a potential hydro-electric power development of less than one and one-half million horse-power.

France. France possesses great possibilities of hydro-development, some of it already available. She possesses the start of a great electrochemical industry, early entering the field of electro-steel, aluminum, caustic and fine chemicals. Her coal supply is deficient but other raw materials are plentiful, as are also transportation and labor.

Switzerland. Italy. Neither Switzerland nor Italy possesses coal deposits of consequence, yet both are well supplied with water-power. Switzerland early started carbide and ferro-alloy production, but power demands for transportation and manufacture always will hold back the electrochemical industry. Italy, on the other hand, is just at the beginning of important developments. Iron, steel, nitrogen fixation and chemicals will all receive a great deal of attention in Italy.

Russia. Finland. Russia possesses few important hydro-electric possibilities and will be years recovering from her present economic prostration. Finland possesses great hydro-electric possibilities and may develop a small industry, but raw materials are not plentiful and the country lacks all the real fundamentals of a manufacturing state.

England. England in steam power always has been foremost in electrochemical development. She has been the birthplace of many industries which have moved to more favored locations. The rising costs of fuel in England will not revive some of these departed industries, but steam power costs are decreasing slowly with the larger units being developed and the life of the industry as now existent will be prolonged. The metal-working industries easily can survive on steam, and electrolytic refining is gaining a strong foothold. The water power resources, while not large, are fair and are being closely investigated.

Asia. Asia is of little present interest to us. Siberia has no remarkable water possibilities, in fact very meagre ones. She has no industrial foundation to build on and may be dismissed from consideration for a long time. More than water and a drop in elevation is required to establish an electrochemical plant. China has much potential water power but very little organized industry. Its development is remote, even though labor and raw materials are plentiful; transportation is most primitive. Manchuria possesses one Japanese-directed, gas engine-driven electrochemical plant.

Japan with her limited supplies of fuel is developing her water powers and possesses several important electrochemical plants. Her engineers are alive to the importance of this industry and more can be looked for, as her hydro-resources are not nearly exhausted. India possesses great water power possibilities. While no electrochemical industry exists at present, the governmental programs for comprehensive development mean that only a few years will elapse until nitrogen fixation and electric iron and steel will be established. Labor is cheap, transportation is fair and a wide variety of raw materials are available though scattered. Home markets await the bulk of the possible products. India probably has more available water power than the United States.

Australia. Australia possesses few potential water powers of note and will not figure in the future competition for the home of the industry. The East Indies, on the other hand, with their wonderful power possibilities and raw materials will some day possess at least a nitrogen fixation industry for home consumption, and metals are not excluded.

Africa. Africa need hardly be considered, the few really great water powers being badly located from the electrochemical standpoint. Markets are few, transportation not particularly good, and raw materials while probably present in rich variety, are undeveloped. Egypt may some day acquire a nitrogen industry, as will also South Africa.

South America. The potential water powers of South America are not conveniently located to the source of raw materials, and fuel deposits are of questionable value. Transportation is costly, to say the least. This field, however, is being closely studied and an electric steel industry is not a remote possibility. Governmental assistance is likely to promote development. Mexico and Central America will never be factors in our industry, the limited powers being turned more profitably to public service and mining.

Canada. Canada possesses many very cheaply developed water powers, but located in districts that contain no fuel. These powers will find their best outlet in public utility, railroad and manufacturing fields. Transportation of raw materials and products play too great a part in the industry to make for greatly increased developments, and the distances are rather great for effective transmission.

Niagara power will find increased uses in manufacturing, with electro-steel and ferro-alloys as the most important electrochemical industries. A few important hydro developments will at some time make power available on navigable water, and this places Canada in nearly as favorable a position as Norway. Newfoundland is in much the same situation as regards power developments close to tide water.

United States. In our own country, its wealth of raw materials, its widely distributed fuels and excellent labor and transportation, have assisted in notable electrochemical development, despite the fact that real low-priced water power is practically unknown. Our one really great power at Niagara is loaded to the limit of present development with the widest variety of plants. As more and more water is made available to the power plants, not only will local developments increase but transmission will carry the energy to distant fields. Instead of 1,000,000 horse-power we should be generating 5,000,000.

The great southern power developments will not be available for heavy electrochemical developments in general; they are too expensive considering their distance from market. Public utilities and manufacturing will consume all they can supply in the future. This will not exclude participation in melting and in mechanical power supply in metallurgical industries. Muscle Shoals never will be another Niagara no matter how the propaganda reads.

The far West has attracted much attention in our field. Public utilities always will take a large share of these developments and transportation some day may demand its proportion, for fuel is scarce. The few possible developments which might yield surplus power are handicapped by the fuel and raw material situation in a region of magnificent distances. Nevertheless, a steel industry is possible and is badly needed.

The struggle for supremacy in the electrochemical industry is going to be between the United States, Norway, India, China and Canada. We are far in the lead now, but our rapidly developing manufacturing industries gradually will attract the cheap power now available to the chemical industry, for they are better able to pay the higher price. Many continuous hydro-powers can only be inefficiently used in most manufacturing industries, and such should be reserved for the continuously operating furnace processes. Regulation of this kind, however, is today impossible.

The Chemically Trained Man and Citizenship

By R. E. Chase, Jr.

Secretary, Chemical Engineering Council of the Olympic Chemical Club, Tacoma, Wash.

WITH reference to the nationwide effort which is now being directed towards the upbuilding of the chemical and chemical engineering professions, chemists everywhere will be interested in the action which has been taken by the Olympic Chemical Club of Tacoma, Wash. This club, at its regular monthly meeting on April 11th, adopted the appended charter which creates an active body of six members to cooperate with other civic organizations in the upbuilding of the community.

I believe that all independent chemical societies and sections of the American Chemical Society might consider taking similar action. Furthermore, it is directly in line with the project of the American Institute of Chemistry as the distinctively economic organization of chemists.

The personnel of the first Council comprises: T. J. Porro, Porro Biological Laboratories; J. E. Berkheimer, Berkheimer Mfg. Co., benzol, tar, pitch, roofing paper, etc.; Dr. S. A. Huntington, formerly dairy expert of the Tacoma Health Department; Douglas Stewart, E. I. du Pont de Nemours & Co.; and R. E. Chase, Tacoma manager, I. F. Laucks, Inc., custom chemists, Seattle, Wash.

William Stedman, president of the Olympic Chemical Club, is ex-officio a member of the Council. Mr. Stedman is manager of the National Cocoanut Butter Co. The Council plans to meet once a week for luncheon and has already begun to carry out its duties in accordance with its charter, giving every evidence of filling a very real need in the community.

Charter of Chemical Engineering Council for Public Welfare—Olympic Chemical Club

The Chemical Engineering Council, hereafter called "the Council," shall be a permanent body of five members, selected from among the membership of the Olympic Chemical Club for the purpose of promoting the general welfare of the community in matters pertaining to chemistry, and also to promote the welfare of the chemical profession.

The activities of the Council shall be independent of the Olympic Chemical Club, except that the members of the Council shall be individually responsible to the Club for carrying out the purposes of the Council, and maintaining the dignity of the profession at all times, under penalty of impeachment as hereinafter set forth.

Organization

The details of organization and duties of the Council shall be as follows:

The members shall be appointed by the president immediately, to serve for the term of the president. As soon as practicable thereafter they shall meet and choose by any method they shall see fit, necessary officers, and shall adopt a system of by-laws, the same to be approved by the Club. Vacancies in the Council shall be filled by the president as soon as possible. The president of the Club shall be a member of the Council ex-officio.

Duties

The duties of the Council shall be to promote the welfare of the community and the profession—

1. By aiding in the establishment of desirable new industries.

2. By assisting already established industries to develop along sound and proper lines.

3. By leadership of the community towards better conditions in sanitation, water supply, food inspection, manufacturing and marketing conditions, and any matters relating to health and safety as bearing upon and related to the science of chemistry.

4. By educating the public to the advantages of a better appreciation of chemistry and a larger use of professional chemists and chemical engineers.

5. By raising the professional ethics of chemists and chemical engineers.

6. By the exercise of constant vigilance to protect the public from false steps in matters related to chemistry and from being victimized by ignorant or unscrupulous promoters in matters relating to chemistry.

7. By cooperating with other organizations and agencies in the upbuilding of the community, this cooperation to be limited, however, strictly to matters in which chemistry is involved.

8. By studying the industrial resources of the community and being prepared at any time to supply data to those seeking to establish or develop industries.

The Council, however is directed specifically to avoid, as far as possible, giving free consulting service or encroaching upon the field of qualified experts. The work of the Council is rather to promote public welfare by expanding the field in which professional chemists and chemical engineers can operate for a respectable remuneration. Nothing in this charter is to be construed to mean that free work of a consulting nature is to be done for anybody, except occasionally when it is thought that a strictly limited amount of such free work might be justified as advertising or publicity, directed towards the development of remunerative work.

The Council shall submit a report of its activities to each regular meeting of the Club.

Any member of the Council may be impeached by the Club for unprofessional conduct damaging to the Council or the Club. Such impeachment proceedings will be conducted by the Club with all due care and consideration for the rights of the accused.

Eighth National Exposition of Chemical Industries

The 8th National Exposition of Chemical Industries will be held this year in the Grand Central Palace, New York City, during the week of September 11-16, inclusive. It will follow immediately upon the Fall meeting of the American Chemical Society. "Raw Materials, Machinery, Products" is the slogan for this year's Exposition.

Messrs. Roth and Payne, co-managers, report that three full floors and part of the fourth of the Grand Central Palace already are taken for the Exposition, embracing 359 exhibitors who have contracted for their space locations.

The program of the Exposition has been outlined and work is now in progress upon it and it may be expected to compare fully with the high standards of the preceding Expositions. As has been the custom there will be exhibits of motion pictures covering all phases of the chemical industries and the Exposition will hold many interests for every visitor.

View of the Artificial Camphor Plant of the Monsanto Chemical Works of East St. Louis, Mo., Showing in the Background the Power House and Electrolytic Chlorine and Caustic Soda Plants. Construction Has Been Arrested Because of the Uncertainties of Legislation

A Domestic Synthetic Camphor Industry

IN March CHEMICAL AGE appeared an article, "Rise and Fall of the Domestic Potash Industry," in which was set forth the present status of the domestic potash industry in which by the end of 1920, $28,696,143 had been invested, in political assurance that on the termination of hostilities a sliding-scale protective duty would be granted for a period of five years at the end of which potash would be placed on the free list. The sale by German and foreign potash-producers of the domestic requirements for the season of 1922, effectually shut down the American industry which now regards with much uncertainty the outcome of the matter in Congress.

The experience of the Monsanto Chemical Works, St. Louis, Mo., in undertaking the domestic manufacture of synthetic camphor in opposition to the Japanese monopoly of the natural gum is analogous to that of the potash producers; with the mitigating circumstances, however, of much smaller investment and of fewer interests involved. For the past 11 years the annual imports of camphor have amounted to 4,750,000 lbs., 90 per cent. of which was used in the manufacture of nitro-cellulose plastics in their innumerable forms, and the remainder in medicinal compounds, etc.

Camphor Monopoly

Practically the entire world's supply of natural camphor is in the hands of a Japanese government-controlled monopoly, organized in 1899, which has complete control of the natural camphor industry, regulating production, distribution and consumption. According to the U. S. Tariff Commission, the Japanese government in its control of the monopoly licenses producers of camphor and camphor oil, who are required to keep strict account of their manufactures and to sell all camphor produced to the government at a fixed price. The refining of crude camphor is the exclusive right of the State. The government reserves the right to restrict production. The camphor is now sold by the monopoly direct to a single agency—Samuel Samuels, of London, with branches in New York, Hamburg and probably elsewhere. Conflicting statements are found as to the extent to which the Japanese government fixes the selling price, but its ability to do so is evidently chiefly limited by the competition of synthetic camphor and the exactions which the celluloid industry will bear, as the production of natural camphor outside Japanese control has not normally reached large proportions.

The strictness of the Japanese control of her camphor monopoly is evidenced by the testimony of Nathan M. Clark, vice-president, the Celluloid Co., Newark, N. J., Jan. 26, 1921, before the Ways and Means Committee, to wit:

"The competition from Japan threatens to annihilate us. Europe and America are in a similar postion as regards camphor, which enters largely into our commodity, but Japan rules the world as to this item. We are at her mercy when we buy camphor. She tells us how little or how much we may have, the price we must pay, and has systematically reduced our supply."

In addition to fixing world prices, the Japanese monopoly arbitrarily, allocates such quantities of camphor not exceeding three months' supply to the various large consumers in countries other than Japan. These quantities are fixed by the monopoly regardless of the buyers' views, which policy in turn determines the output of celluloid permitted to compete with the Japanese product. The allotment for the second quarter of 1922 has just been made. The Japanese monopoly, in its allocations, undoubtedly discriminates in favor of the Japanese celluloid manufacturers in the matters of quantity and possibly price.

The following table showing market prices for camphor in the United States during the past twelve years, is submitted as reflecting the manipulations of the Japanese monopoly.

	High per lb.	Low per lb.		High per lb.	Low per lb.
1915	$ .44½	$ .41	1921	$1.00	$ .75
1914	.59½	.41	1920	3.30	1.00
1913	.44	.42	1919	3.30	2.50
1912	.44	.41	1918	1.34½	.76½
1911	.49½	.42	1917	.89½	.74½
1910	.45	.42	1916	.86½	.42

Synthetic Camphor

The raw material of synthetic camphor is turpentine, peculiarly an America product available here in greater quantity than elsewhere in the world. Synthetic camphor is of more uniform quality and purer than the natural gum. The success of two German producers, viz., Chemische Fabrik auf Actien, Berlin, and Rheinische Kampfer Fabrik, Düsseldorf, is evidenced by the absence in Germany of camphor imports since July, 1920, for use either in celluloid manufacture or for other purposes.

In seeking to establish the synthetic camphor industry in America the Monsanto Chemical Works has expended over $600,000 for process and plant, which project anticipates an ultimate expenditure of $1,000,000 additional. In presenting the above facts to Congress, the company asks for an ad valorem duty of 25 per cent. on synthetic camphor, with the proviso that such duty will not become operative until synthetic camphor is actually produced in the United States in such quantity as approximately will supply 40 per cent. of the country's requirements.

Precedents

Tin plate and Solvay soda products are classic examples of foreign industries transferred to American soil as the result of legislative encouragement without which their domestic production would have been impossible. Domestic synthetic indigo manufacture is the creation of the embargo of war. The entire American market is now supplied with American-made synthetic indigo, and some quantities are exported.

It is submitted that such encouragement as the initial efforts to establish synthetic camphor manufacture in the United States warrant, is advisable because

1. It overcomes the objections voiced by camphor importers and celluloid manufacturers, that protection is not needed where a domestic industry does not exist.
2. The industry will furnish employment for hundreds of American workmen.
3. It encourages investment of American capital in an American manufacturing industry.
4. It will increase the consumption of an American natural product—turpentine.
5. It assures America independence from foreign monopoly of an important article needed by our industries.
6. It removes the possibility of the price again being raised to exorbitant figures.
7. It assures American consumers of a steady supply and a reasonable price at all times for camphor.

Government Phenol For Sale

Government stocks of phenol now on hand amount to 6,879,627 pounds, and all is for sale. The material is stored in drums of 55-gallon and 110-gallon capacity, the latter constituting about four-fifths of the whole. Some of the drums are of the thin destructible type, while others are stout reusable drums. The government prefers to sell the material and containers together.

The phenol is located at the following points, in the amounts specified—Brunswick, Ga., 126,091 pounds; Little Rock, Ark, 1,199,048 pounds; St. Louis, Mo., 126,639 pounds; Westville, N. J., 184,075 pounds; Columbus, Ohio, 4,366,370 pounds; Charleston, S. C., 877,404 pounds. These amounts are not guaranteed in each case, but any sales of the material are conducted on the basis of actual weight.

The government would rather sell the material "as is, where is," but is willing to load it and sell f. o. b. points of storage, which is believed more satisfactory to purchasers. All of any part of the stock will be sold as the government is anxious to get rid of it.

Interested parties should get into communication with the Director of Sales, War Department, Washington, D. C., or with the Monsanto Chemical Works, St. Louis, Mo. This company has acted as sole agent for the government in the sales of this phenol and has disposed of about 20,000,000 pounds of it at prices fixed by the government from time to time. The last sold was about a year ago at 12 cents per pound.

The National Lime Association will hold its annual convention on June 14-16, at Hotel Statler, Cleveland, Ohio. The meeting will be devoted to the consideration of the technology of the uses of lime and of the problems arising in its production and distribution.

Chemical Equipment Association

At the meeting Sept. 17, 1921, at the Chemists' Club, New York, of representatives of leading manufacturers of chemical equipment, an organization committee was appointed to formulate plans of organization of an association of chemical plant equipment manufacturers.

This committee comprised J. George Lehman, Bethlehem Foundry & Machine Co., Bethlehem, Pa., Chairman; A. A. Holmes, E. B. Badger & Sons Co., Boston, Mass., secretary; Paul O. Abbe, Paul O. Abbe, Inc., New York; P. C. Kingsbury, General Ceramics Co., New York, and Dr. C. H. Kimberly, Schutte-Koerting Co., Philadelphia, Pa.

In pursuance of its work, a meeting to perfect organization was held, May 10th, at the Chemists' Club at which Dr. C. H. Kimberly, of Schutte-Koerting Co., Philadelphia, Pa., was chairman.

At the forenoon meeting E. W. McCullough, manager, Fabricated Production Dept., U. S. Chamber of Commerce, and W. A. Durgin, head, Division of Simplified Practice, Bureau of Foreign and Domestic Commerce, made addresses extolling the legitimate field of service of trade associations in which encouragement was extended to the formation of a chemical equipment manufacturers' association.

The project of the association and its potentialities in the improvement of conditions in the production and distribution of chemical equipment were discussed by Walter E. Lummus, W. E. Lummus Co., Boston, Mass.; A. A. Holmes, E. B. Badger & Sons Co., Boston, Mass.; M. W. Smith, Duriron Co., Dayton, Ohio; A. H. Stevens, Bethlehem Foundry & Machine Co., Bethlehem, Pa.; C. B. Wright, Nash Engineering Co., Norwalk, Conn.; G. E. Walker, Dorr Co., New York; H. T. Matthews, Quigley Furnace Specialties Co., New York; L. D. Vorce, Precision Instrument Co., Newark, N. J., and by representatives of the chemical trade press.

At the afternoon meeting the provisional constitution and by-laws were studied and put in satisfactory form and adopted. Notable was the comment of H. T. Matthews, Quigley Furnace Specialties Co., on the proposed name of the association, at whose motion "Chemical Equipment Association" was accepted, in which form it represents the first work of the association in elimination of waste in nomenclature.

At the evening meeting addresses were made by Messrs. Roth and Payne of the Chemical Exposition, Alfred Reeves, manager, Automobile Chamber of Commerce, and Robert Everett, secretary-manager, Association of Ice Cream Supply Men. A committee was appointed to work out plans for the future exposition exhibits of the association, comprising the following members with W. W. Smith, of the Duriron Co., as chairman: A. H. Stevens, Bethlehem Foundry & Machine Co.; H. T. Matthews, Quigley Furnace Specialties Co.; R. C. Campbell, United Filters Co.; C. L. Bryden, Vallez Filters Co., and Chemical Equipment Co. A nominating committee was appointed to select a roster of permanent officers whose names will be submitted to the members for voting.

The American Fertilizer Manufacturers' Association, with [illegible] members scattered all over the country, has been formed with a view to combining resources in effecting economy in purchases. Headquarters will be maintained in Norfolk. Elizah C. Hutchinson is president, W. N. Gregory, vice-president, and David Kurtz, of Trenton, N. J., secretary. The organization has been incorporated for $[illegible]

Constitution and By-Laws—Chemical Equipment Association

THE name of this association shall be Chemical Equipment Association.* The purpose of this association shall be to foster trade in chemical process equipment. In order to do this it shall be the aim of the association to:

Encourage high standards in the industry.

Promote a better knowledge of conditions controlling the industry's development.

Take steps to bring about definite understanding as to professional services rendered to purchasers in connection with sale of equipment.

Investigate conditions surrounding the resale of equipment originally produced for specific purposes.

Disseminate information as to methods of arriving at correct costs.

Standardize trade phrases.

Collect and disseminate information as to design, raw material and construction.

Take suitable and timely notice of, and action upon, matters of legislation, both national and state, which affect the members of this association.

Collect and disseminate market statistics both domestic and foreign.

Collect and disseminate information as to labor conditions and relations.

And enter into such other legitimate trade association activities as may be deemed in the interest and welfare of the industry.

It is distinctly understood that this association will not undertake any activity which will restrain trade, limit production or competition, regulate prices, or otherwise be in violation of the law.

Section 2—Membership

Membership shall be divided into three classes: active, associate, and honorary.

Active membership shall be composed of manufacturers and their agents and others engaged in the manufacture and sale of equipment and accessories used in the chemical industries and industries using chemical processes. Only active members shall vote and hold office.

The associate membership shall be composed of such individuals, firms or corporations as are interested in the activities of the association. For example, consulting engineers and technical publications.

Any individual, firm or corporation qualifying for either of the above classes of membership, upon recommendation of the membership committee and the majority vote of the board of directors, and upon subscribing to the constitution and by-laws of the association, shall be declared elected to membership of this association. Payment of the annual dues shall be required within 30 days after election.

When a member has ceased from active participation in the work of the association, either because of retirement from business or change of position and has rendered distinguished service, either to the association or the industry, he may be accorded the rank of honorary member.

During term of office the presiding officer of affiliated technical societies such as American Chemical Society, American Institute of Chemical Engineers, American Oil Chemists' Society, etc., may also be accorded the rank of honorary member.

The proven participation of any member in any agreement to restrain trade, limit production or competition, regulate prices, or other conduct prejudicial to the interests of the association, shall be reason for immediate expulsion by a majority vote of the board of directors.

Section 3—Board of Directors

There shall be a board of directors of seven members consisting of the president, ex-officio, and six others elected by the association. Of the original board, two members shall serve for 3 years, two members for 2 years and two members for 1 year from date of election. Thereafter, members of the board shall be elected annually to serve for 3 years. They shall have general supervision over the affairs of the association.

Section 4—Officers

The officers of the association shall be: president, vice-president and a secretary-treasurer.

Officers shall be elected at the annual meeting of the association. Ninety days prior to the annual meeting the president shall appoint a nominating committee of three who shall select at least two candidates for each office to be filled. Any other candidates can be nominated in writing by five or more active members of the association. All nominations shall be placed in alphabetical order on the ballot, which shall be mailed 30 days before the annual meeting. The ballots may be mailed to the secretary or brought to the annual meeting in envelopes unmarked, these envelopes being inclosed in others having the signature of the member voting. The nominee for each office receiving the highest number of votes shall be declared elected. In case of a tie the board of directors shall elect one of the two.

No member of the association shall be elected to the office of president more than twice in succession and there shall be a lapse of at least 3 years before he shall again be eligible for such position. The president and vice-president will hold office 1 year or until their successors are elected and qualified.

Section 5—Duties of Officers

The duties of the officers shall be as follows:

The president shall preside at all meetings of the association and act as an ex-officio member of board of directors. In his absence, the vice-president shall preside. In the absence of both the president and the vice-president, the members present at any meeting may by a majority vote, elect a chairman pro tem. to preside over such a meeting.

The following standing committees shall be appointed annually by the president, each to consist of at least three members: Membership, Standardization, Business Ethics, Industrial Relations, Statistics, Legislative and Publicity.

The secretary-treasurer shall be appointed by the board of directors and be directly responsible to them. The secretary-treasurer shall keep proper records of the meetings and all formal actions of the association and its committees. He shall have the custody of all its records and papers in general.

Statistics and other confidential information received from members shall not be communicated to other members without specific permission of the member giving same, but nothing in this section shall be construed to prohibit the compiling of records and statistics *en bloc* or in totals and the furnishing of such compilations to all the members. He shall on request give to the president the names of members reporting and not reporting.

He shall on order of the president issue written notices of all meetings of the association to members. He shall have the custody of and receive and disburse all funds of the association. He shall give bond in such sum and with such surety as the board of directors shall determine and such bond shall be held in custody of the president.

---

*Organized May 11, 1922, at the Chemists' Club, New York.

The books and accounts of the secretary-treasurer shall be audited at least once a year by a suitable disinterested accountant to be selected by the board of directors. Such accountant shall not be connected with the chemical equipment industry.

The secretary-treasurer shall hold office during the pleasure of the board of directors.

Section 6—Dues

The annual dues of the active members shall be $100.

The annual dues of the associate members shall be $50.

Honorary members shall not be subject to either dues or assessments.

There shall be an initiation fee, the amount to be determined by the board of directors and it shall become effective when so determined.

The first annual dues are payable within 30 days of election; thereafter dues are payable quarterly at the option of the member. Membership shall be dated from the first of the quarter during which the member is elected.

Any member who shall become 90 days in arrears for dues and assessments shall cease to enjoy any benefits of the association. If he shall become 6 months in arrears he shall be subject to expulsion at the discretion of the board of directors.

Funds required in excess of revenue from dues are to be secured by assessment upon active members upon a basis to be determined by the board of directors and accepted by the memers of the association. The association may also accept gifts, subscriptions and other funds for specific and general purposes.

Section 7—Meetings

The annual meeting shall be during the month of September and at the main office of the association.

The president shall call all other meetings of the association. In his inability, the vice-president shall have power to do so. A meeting shall be called at the written request of any seven members of the association.

At any business meeting the association members may be represented and vote as follows: Representation at the meetings of the association shall be only by designated representatives of the members, each member to have one vote.

Section 8—Publicity

The records of the association, its files and its correspondence and its meetings shall be open at all times to any public official who in the performance of his duties is legally authorized to investigate the workings of the association; the fundamental object of the association being perfect frankness and openness in all of its activities.

Section 9—Amendments

This constitution may be amended by a vote of three-quarters of the members present at any annual meeting, provided a notice of such amendment has been sent to all members by the secretary 60 days in advance of such meeting.

Section 10—Order of Business

The order of the business shall be as follows:

1. Calling the roll
2. Reading minutes
3. Reports of officers
4. Election of officers
5. Reports of committees
6. Executive announcements or unfinished business
7. [illegible]

Section 11

The parliamentary rules as contained in Roberts' Manual shall be recognized as basis for rules of order.

Canadian Institute of Chemistry Third Annual Meeting

The Canadian Institute of Chemistry held its third annual meeting on May 17 at Ottawa in conjunction with the annual meeting May 15-17 of the Society of Chemical Industry. The meeting began at 10 a. m. and adjourned at 6.30 p. m. The president, Professor J. Watson Bain, took the chair. The secretary-treasurer's report was read and after a vigorous discussion adopted without amendment. Reports were then submitted by the various committees, including a paper on Publicity by Wm. C. Lodge, F. C. I. C., chairman of the Publicity Committee and a very carefully prepared report by Mr. S. J. Cooke, F. C. I. C., chairman of the Remuneration of Chemists Committee. There were no scientific papers given, the whole day being devoted to the discussion of matters pertaining to the profession of chemistry by representatives from the various parts of Canada including British Columbia and Nova Scotia.

At noon the first meeting of the new Council was held and the following officers elected: President, Dr. John S. Bates, the Bathurst Company, Bathurst, N. B.; vice-presidents, F. J. Hambly, Esq., Buckingham, Que.; Professor Matthew A. Parker, University of Manitoba, Winnipeg, Man.; and Professor E. G. R. Ardagh, University of Toronto, Toronto, Ont.; Secretary, L. E. Westman, Esq., 57 Queen street, West, Toronto, Ont.; treasurer, Professor E. G. R. Ardagh, Esq., University of Toronto, Toronto, Ont. The other members of Council are: Dr. A. T. Charron, Provincial Laboratories, St. Hyacinthe, P. Q.; J. A. Dawson, Esq., 326 Howe street, Vancouver, B. C.; Professor W. Lash-Miller, University of Toronto, Toronto, Ont.; I. C. Mackie, Esq., Dominion Iron & Steel Co., Ltd., Sydney, N. S.; Dr. A. C. Neish, Queens University, Kingston, Ont.; Professor A. Lehmann, University of Alberta, Edmonton, Alta.; Dr. R. F. Ruttan, McGill University, Montreal; Harold J. Roast, Esq., 393 Guy street, Montreal, Que.; Dr. T. Thorwaldson, University of Saskatchewan, Saskatoon, Sask.; and F. G. Wait, Esq., Mines Branch, Ottawa, Ont.

The afternoon was devoted to further professional discussion of the economic status of the chemist. At an evening meeting of the Council the various committees were made up, including William C. Lodge, 60 Sherbrooke street, West, Montreal, Chairman of Publicity Committee, and Harold J. Roast, 393 Guy street, Montreal, Chairman of Legislation Committee.

In the evening the annual dinner of the Institute was held. A most enjoyable evening was spent, a number of ladies, both chemists and friends, being present. After the toast of the King and the Prince of Wales, Professor M. A. Parker proposed the toast of our guests which was replied to by Hon. Jacques Bureau, Minister of Customs and Excise, Mr. J. H. Harris, M. P., and Mr. C. W. Good, M. P.; various other toasts were proposed and replied to. At the close of the dinner a presentation was made to Mr. and Mrs. Roast by Dr. L. F. Goodwin, on behalf of the members of the Canadian Institute of Chemistry in recognition of the retiring secretary's constructive work in the organization of the chemical profession of Canada during the last four years. Mr. Roast in reply stated that the only reason for his resignation was the matter of health and in thanking the members for their kind appreciation said that he had no doubt but that the Institute would continue its growth and accomplish the end for which it was constituted, viz., the raising of the status of chemists and the development of the raw and manufactured materials of Canada.

Oxygen Production by the Claude Process

THE New England Association of Chemistry Teachers of which Charles H. Stone, Boston English High School, is president and S. Walter Hoyt, Boston Mechanic Arts High School, is secretary, recently visited the Boston plant of the Air Reduction Sales Co., at Dorchester, Mass. The following description of the plant and process of oxygen production is from the Association's official account of the visit, in which is expressed appreciation of the courtesy of District Manager J. A. Shand and Superintendent Stauffer.

The Claude Process

The process in operation is known as the Claude process and is installed primarily for the production of pure, gaseous oxygen from air. Nitrogen and argon may be recovered if desired, but most of the nitrogen is allowed to return to the atmosphere after its separation from the oxygen. The production of liquid air is merely incidental to the process and it is not put on the market. Teachers, however, may obtain liquid air for experimental uses by applying at the plant and furnishing suitable containers.

The peculiar merit of the Claude process is the comparatively low pressures at which air may be liquified with other commercial processes.

Removal of Carbon Dioxide

Atmospheric air is drawn in through a pipe through the roof and passed to the bottom of a steel tower about 20 feet in height. This tower, which is virtually a giant gas-washing bottle, is equipped with spiral tiles running from top to bottom, down which a concentrated solution of sodium hydroxide is constantly flowing. As the air ascends, most of its carbon dioxide is absorbed. The spent sodium hydroxide is thrown away. The air then passes through a second tower exactly like the first, except that the caustic soda solution is not allowed to become spent, and so removes practically all of the carbon dioxide. If the carbon dioxide were not removed at this stage it would solidify during the subsequent cooling of the gases and would completely choke the apparatus.

Compression and Cooling

As the air emerges from the second wash tower it is passed into a receiver on the suction line, then given a compression of 85 lbs. per sq. in. and is cooled in a system of tubes immersed in running water. At this point a portion of the water vapor is condensed and removed. A second compression and cooling follows, the pressure being raised to about 450 lbs. per sq. in., the temperature being reduced to practically that of the room. The first cooler is called the "inner cooler"; the second, the "after cooler." Each compression, of course, heats the gas. This heat is removed by the water coolers, which are essentially systems of spiral copper tubes surrounded by cooling water jackets.

Exchanger

After the second compression and cooling, the gases are sent to the bottom of a small, steel tower, known as the "exchanger." This is the part of the apparatus where the heat of the incoming high pressure air is given up to the cold, outgoing separated gases. This is brought about by having the "exchanger" so constructed that the compartment carrying the cold outgoing separated gases is surrounded by the compartment carrying the ingoing compressed air. The ingoing air is here cooled from room temperature to about 84 degrees C., while the outgoing gases are, of course, warmed. The outgoing gases are the nitrogen, argon, etc., which are boiling off from the liquid air.

Liquifier

From the "exchanger" the ingoing air enters the "liquifier," which is constructed on the same plan as the "exchanger." At this point the outgoing gases are at the lowest temperature and a portion of the ingoing compressed air is liquified. This liquid air, together with a portion not liquified, is passed to a compartment where further cooling takes place and much of the remaining oxygen is liquified. This is brought about by the air ascending a system of small vertical tubes immersed in liquid air.

Rectifier

As the air passes up these tubes the oxygen is progressively liquified and runs back into its compartment at the bottom, cooling and liquifying more oxygen as it descends. The liquid, therefore, collected here is rich in oxygen. The residual gas passes on to another compartment where its temperature is reduced to a point at which the remainder of the oxygen and all the nitrogen is liquified. The liquids from these two compartments are kept separate and are drawn off continuously through adjusting valves and poured over a system of trays in a vertical tower placed directly above the liquifier. This vertical tower, or rectifier, is practically identical with an alcohol rectifying still.

The liquid rich in oxygen is poured upon the trays about half-way up the column, while that rich in nitrogen is poured in at the top. Rapid evaporation occurs here, the more volatile nitrogen passing to the top of the trays and the liquid oxygen running down to the bottom trays, where it arrives practically pure, and is sent to a compartment surrounding the tubes in which the first liquifaction took place. This heat exchange, of course, vaporizes the oxygen.

Separation of Gases

The nitrogen gas, as it passes from the top of the still, is at the temperature of—192° C. and is, in like manner as the oxygen, sent to the "liquifier," but of course in its own compartment, separate from the oxygen. Both gases, each in its own compartment, pass backward through the exchanger, cooling as they go the incoming compressed air. The two gases reach their respective exits, after passing through the exchanger, at practically room temperature. The nitrogen is allowed to escape to the atmosphere and the oxygen is passed to the gas-holder.

Expansion Engine

If the entire system were one hundred per cent. efficient in the matter of heat insulation, no other apparatus would be required. However, heat inevitably leaks into the system from the surroundings, and this energy must in some manner be removed. This is accomplished by diverting a portion of the incoming high pressure air to an expansion engine in which the pressure is reduced from 475 lbs. per sq. in. to 75 lbs. per sq. in., internal work being done by driving a small dynamo. This energy taken out is just equivalent to the heat which leaks into the system, and amounts to about 4 H. P. This energy is dissipated as heat in a set of resistance coils. The expansion of the air in this apparatus lowers the temperature of this portion of the incoming air from -84° to -135°C.

Exchanger in Duplicate

The exchanger is installed in duplicate and the circuit so arranged that after three or four hours' operation on one exchanger the cold outgoing gases and the compressed incoming gases are thrown to the alternate exchanger, while the accumuated ice and water are thawed out and removed.

Gasometer

The oxygen issuing from the cooling jacket of the exchanger is passed into a gasometer of the inverted bell type, similar in all respects to that used at the coal gas plant.

Compressed Oxygen Gas

The oxygen is drawn from the gasholder as needed and compressed slowly into the oxygen cylinders to a pressure of 2,000 lbs. per square inch. A cylinder weighs about 130 lbs. empty, 148 lbs. full, and contains 18 lbs. of oxygen, which is about 220 cu. ft. of gas at normal pressure. The gaseous oxygen is forced into the cylinders until the gauge reads 2150 lbs. per sq. in. This compression heats the gas; upon cooling to 68°F. the pressure is reduced to 2000 lbs. per sq. in. through contraction.

Pressure Cylinders

These are made of pressed steel about one-fourth inch thick. The regulation of the United States Bureau of Combustibles requires that each cylinder be tested once in five years and the date of testing stamped into the cylinder. The test is made at 3600 lbs. per sq. in. with hydraulic pressure, the requirement being not more than 10 per cent permanent expansion in relation to the total expansion at the end of four minutes. This averages about 150 c.c. at 3460 lbs. hydrostatic pressure. In filling the cylinders, the greatest care must be taken that no oil enters, as this would cause an explosion. The company has 200,000 cylinders in constant use. Each cylinder is provided with a safety device consisting of a copper disc placed in the valve at the top. A hole will be blown through this disc, allowing the oxygen to escape, before dangerously high pressures are reached.

Price of Oxygen

The price of compressed oxygen is now $2.00 per 100 cubic feet to the trade. The company does not sell its tanks, which cost about $35.00 apiece, but loans them to customers, replacing the empty tanks with full containers as required. A reduced price is offered to educational institutions upon application.

Purity and Output

The oxygen made is very pure, well above the Government standard of 98.2 per cent and, as no chemicals except caustic soda are used in this process of manufacture, no further purification is required when the oxygen is used for medical purposes. The Boston plant has a capacity of [illegible] cubic feet of oxygen per day, being known as 50-meter unit.

[illegible] W. [illegible] and M. J. [illegible], formerly respectively with Commonwealth Edison Co. and Sears, Roebuck & Co., Chicago, are recent accessions to the staff of Redmanol Chemical Products Co., Chicago.

Acids and Accidents

By Charles E. Sholes

My first introduction to acid burns was one which will never be forgotten. It was during the school vacation period and I was learning laboratory routine and was particularly charged with washing of apparatus. Outside and only a short distance from the laboratory was a new chamber building in which carpenters were erecting a wooden truss to support a great lead pipe which would connect the lead chambers with the "cold" towers. Underneath the truss was an open tank in which some oil of vitriol was stored temporarily.

One of the carpenters had been a circus acrobat and during the lunch hour he amused a throng of workmen by stunts on the new truss until—he slipped. When they brought him into the laboratory the new boy cut off his clothing and boots and helped to wash the screaming man with alkaline solution to neutralize the acid. But the acid had reached his eyes, ears, throat and lungs and after three days of frightful suffering the man died.

Since then I have given and directed first aid in many other cases of acid burns, and by an analysis of causes have come to the conclusion that this class of accidents is more often due to crude and inadequate tools than to the faults of workmen or workmanship. In a great majority of cases the accidents seem to be due to mistakes in handling, defective containers, slopping or spattering and fluid left in containers which are supposed to be empty. The rough handling of carboys, the breaking out of loose boards on carboys which have been attacked by the acid, and the unnecessary proximity of operators when carboys are being dumped into vats are among the causes of trouble. Also, some very serious accidents have been caused by using air pressure to empty carboys and drums which are neither designed nor tested for high pressure.

A number of devices for handling acids have been perfected in the light of very complete practical knowledge. For example, there is a two-wheeled truck, built low and with two-inch tires, which operates like a pair of scissors to lift and to convey carboys of any size. Then there is a combined carrier and dumper which locks and pins the carboy between two bars. By means of it two men can dump carboys very rapidly, while keeping well away from the splash. There is a new and very rugged dumper for the complete emptying of carboys to the last drop.

In addition there is an array of containers which will not rust and which are not affected by most acids. Through the use of these and many other such devices acid burns may be avoided and much pain, time and money saved.—*May Bull., Safety Institute of America.*

A National Exposition of Power and Mechanical Engineering will be held at Grand Central Palace, Dec. 7-13, under the management of Charles F. Roth and Fred W. Payne, who are in charge of National Exposition of Chemical Industries. The exposition will be one of apparatus employed in the generation, distribution and utilization of power and is designed to bring into close contact manufacturers, engineers, capitalists, dealers and consumers, and at the same time to enliven the public interest in conserving fuel through its more complete combustion and the more effectual generation of power and its utilization.

[illegible], formerly of the American Vat Color Co., Chicago, Ill., is now with the W. K. [illegible] Co., Bush Terminal, Brooklyn, N. Y.

Robert E Swain

Robert E. Swain

Department of Chemistry, Stanford University

A Pioneer in the Solution of Air Pollution and Dust Recovery Problems

CHEMICAL AGE

Volume 30
Number 5

May
1922

A Consolidation of
The Chemical Engineer
and Chemical Age

EDITORIAL

WHILE the growth of chemical manufacture has been subject to the same laws that control the development of all industry, many points of dissimilarity mark it quite in contrast to those lines of manufacture wherein standardization of parts has permitted a volume and cheapness of production matched no where else in the world.

This contrast arises from the distinction between transformation in the constitution of material and those manufacturing arts essentially mechanical. Mass, solid, liquid and gaseous states, temperature, pressure, and the subservience of properties to the will of the operator, create such variety and delicacy of manufacturing processes as to make the chemical industry a congery of industries. Each product represents a distinctive art. In no branch of manufacture is ingenuity in the handling of materials less restricted or resourcefulness in methods of their treatment less confined; so we find a variety of tool and treatment equal almost to the variety of its products.

To scientific discovery and inventive ingenuity, ever providing new things and new ways, to the innumerable procedures and to secrecy of operation, are due chiefly the low standardization of manufacturing processes which pervade even those lines providing the great staple chemicals in tonnage quantities.

Chemical manufacture is notable in the standardization of its products and shares with all industry the evolution in simplicity of procedure, but is noteworthy for the reasons stated in the absence of standardization of its tools. A prominent chemical equipment manufacturer has declared the chemical industry to be the least conventionalized of all industries.

THE greatest influence in promoting standardized operations is the maker of tools whose enterprise throughout the development of industry always has made possible each step in the progress of the art he serves. The glorification of the chemist has eclipsed the credit due to the toolmaker in chemical manufacture without whose help the triumphs of applied chemistry would be impossible.

Scrutiny of the mechanical equipment of chemical manufacture, despite the variety of its products and procedures, discloses opportunities of standardization which already in England have been seized in the sizes and construction of open kettles.

While specialization in chemical equipment manufacture doubtless will confine early efforts in the direction noted to commonly-used tools, the production and distribution problems of this ancillary department of chemical industry will provide ample field for the activity of the newly organized Chemical Equipment Association.

TO the success of a labor group in inculcating in our economic life the principle that organization is a condition precedent to recognition, can be attributed largely the growth of a movement in American industry that has quickened every branch with the potency of solidarity.

Reflecting the frailties of humankind, the trade association as an artificial individual must learn that its rights end where they meet another's and that these rights, if to be upheld, must be rooted in duties performed and that these duties must flow primarily to the people if the fruits are to be enjoyed by themselves.

Accordingly Herbert Hoover, as an agent of the people, encourages the growth of trade associations in the performance of legitimate functions, but denies the right of unction to those that violate their trust. This trust requires that, in the promotion of the welfare of its members, the trade association shall not subvert the superior and primary welfare of the people, which rests on the ever greater abundance and cheapness of the things of life.

Mr. Hoover calls attention to the fondness of the little fellows for trade associations, remarking that the big fellow can provide for himself the service that the association seeks to render to the former, in an era which recognizes in over-built, over-manned and duplicative industries a prime source of waste and hence of added cost to the consumer. We see in this aspect of current industrial history not only the play of the fundamental motive of segregation, which is individual helplessness, but the desire to control artificially the natural laws of growth, which latter usually is for the benefit of those seeking control.

Elimination of waste, incident to the leveling of the peaks and valleys of industrial activity, must in its larger features be a compromise between the natural law that works for integration and centralized control in industry, and the statute law that seeks to enforce equality of opportunity, even at a cost to the people which in the aggregate is the penalty man pays for violation of the former law and for his slow recognition of the grandeur of the Golden Rule in the relations of men.

PERSISTENT is the patter that the profession of chemistry needs to be advertised that popular appreciation of the chemist will promote his individual welfare. Dr. Volwiler, of the Abbott Laboratories, Chicago, says that "while the profession need not be popularized to the extent that radio is, we need the vision of a Slosson and a Hendrick to present to the public the services that chemistry can render."

A regiment of story-tellers or a grand army of chemists gifted with the fluency of Irvin S. Cobb would add not one milligram to the heft of a chemist's pay envelope or provide jobs for those now out of employment or increase the opportunities for the capacity production of the nation's technical schools.

Quality not quantity is wanted in chemical enterprise. Chemists in industry should view with chagrin such twaddle as we have quoted, which could have no other comparable influence on the welfare of chemists than a visitation of locusts. Selling chemistry to a limited element of the public, with its mildly stimulating entertainment, is a bizarre solution of the economic problems that press upon the pursuit of chemistry.

Practitioners of chemistry court every influence that will improve the morale of the profession, and so will confirm the above observations.

* * *

WITH the expansion of business in iron and steel, spreading notably through the basic industries of motor cars, housing and railroad rolling stock construction and repairs, confidence grows in the progressive stimulation of general industrial activity in which ultimately may be absorbed the idle equipment and labor of the country.

The process, however, continues slow and halting, due to untoward conditions affecting particular lines of production, arising from resistance to deflation, from the uncertainties of legislation or from the weak demand of consuming fields. We cannot dissociate domestic conditions from world conditions; so long as the latter are defiant of the growth of international confidence, instability will cast its baneful shadow upon domestic affairs.

Increase of purchasing capacity of the ultimate consumer is the condition precedent to the general resumption of business. From his power to buy flows, as from a spring, the nourishment of industry, for he pays the wage and provides the profit without which man can not work and save or the plant run and accumulate a surplus to meet the exigencies of growth.

Inability or refusal to buy means that the consumer, whether he realizes it or not, cannot or will not pay the wage that makes up the cost of goods. The way to induce him to buy is obvious.

Price stabilization on a wage rate enforced by class advantage is shot through with such injustice as to make a weak foundation for general prosperity. Business recuperation will reflect the growing recognition of the fact that it is not the money one gets but what it will buy that determines the freedom and volume of exchange of goods and services. Man must subsist and increasing population must be provided for out of his labor. If production is impeded, consumption is decreased and society suffers.

If the purpose of life is the development of character, then a large part of the latter is the consciousness translated into action that the individual finds his life in the larger life of the group and that to injure which is to punish himself. Men must be taught this doctrine in season and out that the precept may be fixed in practice. In its violation lie all the evils that beset mankind.

* * *

REGARDLESS of the virtues of chemistry as a cultural course the pursuit of its advanced study is with the idea of the student qualifying as a producer of wealth in the practice of its technical profession in any one of its many specialized arts. "To have men of forty quit in disgust," or to have the highly specialized product of chemical professional education turn to unrelated fields wherein his academic experience is of little avail, is a most reprehensible sort of waste. It represents a serious lack of coordination between production and consumption in a market that deals with human raw material. Why can not man, in his desire to perpetuate a class, improve upon Nature who produces so prodigiously to assure the exceptionally capable few?

This waste affects enterprise and thrift in fields foreign to chemical industry—the personnel of chemistry does not provide its own recruits; it embraces the time and energy of the teacher; it covers the regrets of the man who, in his post-collegiate years, sees in the requirements of a most exacting mistress the reflection of his own deficiencies; furthermore it indicates a lack of system on the part of the industry itself. Supplying this system and conducting it for the benefit of the producer, consumer and product of professional chemical education are the functions of the economic organization of chemically trained men.

To argue that these functions can be performed within the confines of a scientific society more satisfactorily than in a distinctive, professional organization, is to affront precedent and the laws of growth; is to weaken an educational society, now unwieldy with bureaucracy, that should be strengthened by being held straight to its course; and is to deny to a great group of educated men the economic representation and influence that the growth of the industry and its trained personnel and the seriousness of their problems demand.

Please read in this connection the brief but illuminating account of the formation of the English Institution of Chemical Engineers on page 202.

Regeneration of Catalyzers in Oil Hardening

IN the commercial hydrogenation of liquid fats whereby oils are transformed into industrial and edible products of varying degrees of hardness, according to their use, it is well known that the catalyzers, most commonly finely divided metallic nickel, after being used a number of times, become inert and useless in effecting the introduction of hydrogen atoms in the unsaturated oil.

The loss of catalytic power follows either upon the prolonged use of the catalyzer or upon its use with low-grade material in which are present those substances which have the effect of "killing" the catalyzer, *i.e.*, of reducing its activity. The catalytic action of finely divided metals is attributed to a surface action and, generally speaking, the more extended the active surface of a given weight of metal, the more active is the catalyzer.

The exhaustion of the catalyzer is commonly explained by changes in the surface of the catalyzer particles, arising from combination with the deleterious substances present in the oil. Sulphur and its compounds, as well as compounds of arsenic and phosphorus, are very active catalyzer poisons, a small quantity only being required to destroy the efficiency of a relatively large amount of the catalyzer as a very thin film of inactive compound of the metal on its surface. Surface oxidation of the catalyzer particles also is claimed to be a cause of inactivity.

In the rejuvenation of the "spent" catalyzer the practice has been to separate it from the hydrogenated oil by means of the filter press, removing the press cake therefrom and boiling it with dilute sulphuric or nitric acid. The nickel sulphate or nitrate thus formed is then reduced to a metallic state by means of hydrogen at high temperature. Further to increase the catalytically active surface it has been proposed to distribute the finely divided metal upon carriers of various kinds.

William D. Richardson, chemical director, Swift & Co., has found that chemical processes for the regeneration of the spent catalyst are unnecessary, that its reactivition can be effected mechanically by a "resurfacing" of the catalyzer particles through the use of a finely divided abrasive. Dr. Richardson carries out* the process of regenerating mechanically spent nickel catalyzer which has become inactive in glyceride oil hydrogenation as follows:

The spent nickel catalyzer is removed from the filter press and reduced to a fluid consistency by mixture with a sufficient quantity of the oil. This mass is transferred to a porcelain-lined pebble or ball mill which is operated until activity is restored to the catalyst, the progress of which being determined by removing samples from time to time and determining its activity by hydrogenation tests. From 1-3 hours will be required to effect reactivation according to the apparatus used and the conditions of use, *e.g.*, the size of the ball mill, the charge of pebbles, speed of rotation, amount of oil present, etc. The mill-lining and the balls used should be of a material which when abraded will not contaminate the catalyzer. Porcelain lining and porcelain or flint pebbles are acceptable; likewise, metal balls or nodules of the metal of the catalyst.

To hasten the regeneration of the catalyst, finely-divided abrasive, of about 200 mesh, may be added to the charge, as ground quartz, sand, carborundum, aloxite, alundum, or similar material, which obviously should not be of a character to contaminate the catalyst and which may supplement the reaction. With a finely-divided nickel catalyzer, and a finely-divided abrasive, and particularly when oil is present during the regeneration, the regenerated catalyst will be a suspension of the finely-divided nickel and abrasive in the oil, and will be adapted for use in the form of the suspension for the catalytic hydrogenation of oils.

The rejuvenation may be carried on in the presence of any liquid or gas that will facilitate the process or at any desirable temperature. Dr. Richardson claims that the ball mill is particularly advantageous because its operation provides a combined rubbing, squeezing and percussive action peculiarly adapted to "re-surfacing" the spent catalyzer particles, especially in the presence of a finely-divided abrasvie.

Non-Cracking Patent Leather

Artificial leather made with coating compositions containing polymerized or "blown" oils, *i.e.*, oils thickened by treatment with air or oxygen, has been prone to crack when subjected to a temperature of 0°C. and sharply bent or creased, which property is very disadvantageous when the product is used for outdoor purposes, *e.g.*, in automobile upholstery. This defect arises from the low fluidity or high viscosity of such oils at these temperatures.

James E. Booge, Wilmington, Del., modifies the coating composition whereby the flexibility of the coated fabric is increased by adding non-volatile solvents having a higher degree of fluidity at the lower temperatures than the blown oils, as the methyl or ethyl esters of the higher fatty acids, as lauric, myristic and palmitric or oleic and recinoleic acids. Mr. Booge coats cloth or split leather with one or more applications of a composition made up by weight of the following ingredients: Nitro cellulose, 1 part; blown rape seed or cottonseed oil, 2 parts; methyl or ethyl esters of mixed fatty acids from cocoanut oil, 1 part; volatile solvent, comprising 5 parts ethyl acetate and 3 parts benzene, 7 parts.

By solvent power of the methyl or ethyl esters of the fixed fatty acids from either cocoanut, rape, cottonseed or castor oils, is meant that they must have the property of dissolving in the oil used in the composition and of mixing with the nitrocellulose and volatile solvents present; furthermore, at low temperatures they must not crystallize out in the coating to produce a white "bloom."

American Oil Chemists' Society

Owing to serious flood condition of the Mississippi River, the annual meeting of the American Oil Chemists' Society, which was to have been held at the Grunewald Hotel, New Orleans, on May 8th and 9th, has been postponed to June 5th and 6th.

The program will include addresses by Dr. L. M. Tolman, chief chemist, Wilson & Co.; Dr. J. H. Shrader, director of the Baltimore Municipal Laboratory; Dr. David Wesson, technical director, Southern Cotton Oil Co.; Dr. W. D. Richardson, chief chemist, Swift and Co.; Dr. Geo. S. Jamieson, chemist in charge, Oil, Fat and Wax Laboratory, U. S. Bureau of Chemistry; Mr. C. B. Cluff, superintendent manufacturing department, The American Cotton Oil Co., who is President of the Society; and Herbert S. Bailey, chief chemist, Southern Cotton Oil Co.

---

*U. S. Letters Patent [illegible]

Synthetic Medicinal Chemical Manufacture in America

By Alfred S. Burdick, M.D.
President, The Abbott Laboratories.

BEFORE the Great War this country cut a small, indeed, an almost contemptible, figure in the manufacture of synthetic chemicals of all kinds, and particularly in the production of synthetic medicinals. We are not concerned here with the manufacture of dyes, although dye production and the production of medicinals are so closely interwoven as to be almost inseparable for a clear understanding of the subject. Despite the fact that the United States had almost illimitable sources to draw on for raw materials, its manufacture of medicinal synthetics prior to 1914 was virtually limited to the salicylates, including salicylic acid and its salts, acetylsalicylic acid and salol. These substances were made in this country entirely by German-owned corporations.*

A few other synthetics of closely allied character were being produced in small quantities, the principal ones being saccharin, the invention of an American chemist, and phenolphthalein, the manufacture of both of which was begun, I believe, by the Monsanto Chemical Company prior to 1914. Argyrol, which was also introduced by an American chemist, was being manufactured, but, strictly speaking, this hardly can be called a synthetic. I believe that these are the only medicinals, or near-medicinals, which we produced in any considerable quantity prior to this time.

If we consider this small beginning, and consider also the fact that our chemists were but inadequately trained to undertake the tremendous problem of manufacture of medicinal chemicals in this country, as compared with German chemists whose work rested upon the secure foundation of many years of great achievement, all Americans have just reason to take pride and satisfaction in the accomplishments of the next few years.

Under the stress of necessity, and responding to the call of the government, a number of American manufacturers undertook the production of the most important synthetic medicinals. The number of those which might really be called indispensable was not as large as most of us may have been led to believe. Perhaps there were a dozen all told, and of these all are now being made in the United States. Of course there are many other interesting and valuable synthetic remedies which are made in Germany at the present time and which are not as yet produced here, but for the most part these are remedies of minor importance for one reason or another—perhaps because they are used to replace other remedies of similar action and possibly equal merit, or because they have but a limited field of usefulness.

Of the really important remedies the manufacture of which in America was brought about by the war, probably the most important is arsphenamine, commonly known as salvarsan. Of the other synthetic medicinals made in this country, next in importance and of greater commercial value is aspirin or acetylsalicylic acid. Other synthetics now produced in this country, in about the order of their importance commercially, are acetanilid, barbital (formerly known as veronal), barbital sodium and luminal—chemically closely allied—cinchophen (formerly known as atophan) and neocinchophen, procaine (formerly known as novocaine), anesthesin and orthoform, and sulphonol and trionol. All of these were originally German patented products, although the patents on some of them had expired prior to the war.

The problem which immediately presented itself was that of German patents. Our government was anxious that the most essential of these medicinals should be produced, but the American patents of such important things as salvarsan, veronal, luminal, atophan and novocaine were the property of enemy aliens. This difficulty was overcome by the passing of the Trading with the Enemy Act, which authorized the issuance by the Federal Trade Commission of licenses to manufacture these chemicals.

In order that the maker might receive reasonable protection for his investment, these licenses were made to run for the life of the patent, and the interest of the alien owner was protected by requiring the deposit with the Alien Property Custodian of a 5 per cent. royalty upon sales.

Following the passage of this law, a number of American houses were approached by representatives of the government with the suggestion that they undertake the manufacture of one or more of these products. The Abbott Laboratories immediately began the necessary research work, and eventually manufactured three of these products under license—then known as veronal, novocaine and atophan, at first only for use in the Army and Navy.

At the conclusion of hostilities, after intensive research and the expenditure of considerable money, our organization was making veronal, novocaine, atophan, chlorazene, dichloramine-T, anesthesin, and some other things, as well as, and of as good quality as any European manufacturing house.

The present status of manufacture of synthetic medicinals by American houses is discussed briefly under the following heads:

Arsphenamine

Formerly known as salvarsan, it was renamed "arsphenamine" by the United States Federal Trade Commission, upon the recommendation of the American Medical Association and the National Research Council. All of these German chemicals were given new names, particularly for the purpose of Americanizing these products to protect the American manufacturers, and for the purpose of fostering their continued production in this country after the war. These names were accepted by the Council on Pharmacy and Chemistry of the American Medical Association and will undoubtedly be made official in the next U. S. Pharmacopaeia.

The first licenses for the manufacture of arsphenamine were issued to the Dermatological Research Laboratories, Phila., and to H. A. Metz & Co., New York. The latter was the former American agent for the German manufacturer. The Dermatological Research Laboratories was the first to produce this difficult and important chemical in this country, and for some time before he was able to manufacture it himself supplied Metz with the product which he marketed. Not only did the Dermatological Research Laboratories produce arsphenamine of a quality equal to that manufactured in Germany, but it was able to cut the price to one-half and then considerably less, the result being a saving to American consumers of millions of dollars.

---

*From a paper read at the January, [illegible], meeting, Chicago Branch, American Pharmaceutical Association.

Before the war, at a congressional committee hearing in Washington the statement was made that more than a million doses of German salvarsan were being sold in this country. At the present time the consumption is probably considerably greater. There are said to be ten million cases of syphilis in the United States, so that the demand for this drug is enormous. There are now some five or six licensees, including the Takamine Laboratories, E. R. Squibb & Sons, the Mallinckrodt Chemical Works, and the Diarsenol Co., in addition to those already mentioned. Arsphenamine is being produced of a quality unexcelled in any country in the world. It is a difficult chemical to make, and on account of its toxicity it is important that it should be carefully supervised by a competent authority. This is taken care of by the U. S. Public Health Service, under conditions which make it practically impossible for a chemical of inferior quality to be offered for sale.

Aspirin

The patent on this product expired before the Great War, but the trade mark has been the subject of litigation for several years, and the case is still pending. It is manufactured by a number of American houses. The United States is now probably the largest manufacturer as well as the greatest consumer of this product. According to the 1920 Census of Dyes and Coal Tar Chemicals, 1,708,436 pounds of aspirin were produced here in 1919. It is probable that the present output is in the neighborhood of two million pounds a year. This is the equivalent of 2,800,000,000 5-grain tablets, and at retail must bring at least $25,000,000.

Acetanilid

I mention this drug mainly on account of the large quantity which is being manufactured and used. According to the Dye and Coal Tar Census, 1,255,140 pounds were made in this country in 1919. Doubtless a large share of this goes into proprietary headache powders and tablets.

Barbital (Introduced as Veronal)

Authentic figures concerning the volume produced in this country are not available. Judging from our own experience with the product, and only guessing at the amount produced by other manufacturers, I should say the total American production is more than 25,000 pounds a year. Licenses were issued for its manufacture to Antoine Chiris & Co., Rector Chemical Company and Abbott Laboratories. As far as I know, the Rector Chemical Company has never produced it in appreciable quantities. Upon the sale of the assets of the German house of Bayer to the Sterling Products Company, the barbital patent was acquired by this American firm; manufacture was undertaken by the American house of Bayer, its assignee, and the product is now being sold under license from that corporation by the Winthrop Chemical Company of New York. At the present time there are three manufacturers only—Bayer (Winthrop), Chiris and Abbott.

American-made barbital (veronal) is now selling in this country at about half the price asked by German manufacturers in America before the war. In spite of this, Europeans are clamoring for the admission of their product and have offered it for sale in this country at prices only slightly more than the cost of intermediates and raw material. Considerable quantities have been smuggled into the United States. If American manufacturers are given adequate protection during the critical period of the next few years they will be able to meet any reasonable competition. We make barbital-sodium, the action of which is virtually identical with that of barbital, but the sales are small as compared with barbital.

Cinchophen

Licenses for the manufacture of cinchophen were issued by the Federal Trade Commission to a number of houses, but at the present time it is manufactured under license from the Chemical Foundation only by the Abbott Laboratories, by Calco Chemical Co., and by Schering & Glatz, which controls the trade-marked name "Atophan."

Cinchophen, and to a less degree neocinchophen (also made by the Calco Co., under trade name Tolysin) has been one of the surprises in chemical manufacture. Before the war atophan was used for the treatment of gout, and for this purpose only. During the last two years, particularly, the demand for it has greatly increased—probably because it has been shown to be efficient in the treatment of acute rheumatism and rheumatic conditions generally. Papers by such men as Hanzlik, Chace, Meyer and others have shown it to less irritant to the stomach and less harmful to the kidneys than the salicylates, while it is equally efficient, if not more efficient, for the relief of pain and as an eliminant. I have reason to believe that many physicians are prescribing it instead of aspirin. Probably 30,000 pounds of cinchophen are being made annually in this country. It is being produced in this country at least as cheaply as in England. German costs of production I am not familiar with. Cinchophen will undoubtedly be the official name of this substance, which was formerly known as atophan.

Procaine

This substance was introduced from Germany under the name of Novocaine. It is very widely used as a local anesthetic. Probably 75 per cent. of that sold is used by dentists. Strangely enough, only relatively little of it is used by the medical profession—a fact which is greatly to be regretted because it is a substance which can be employed easily, safely and profitably in thousands of cases in which operation is performed at the present time under ether or chloroform, or, worse yet, with no anesthetic at all.

Procaine is a very expensive drug to produce, but the price is going steadily downward; it is sold, in quantity, at the present time much more cheaply than it was ever sold by the Germans before the war. Licenses were issued for its manufacture to H. A. Metz & Co., the Rector Chemical Co., and the Abbott Laboratories. The present status of its production by the Rector Chemical Co. I cannot say. The largest producer is Metz. The quantity sold can only be estimated, but I believe it cannot exceed 3,000 pounds a year.

Luminal and Anesthesin

The former is manufactured by the Winthrop Chemical Co., which operates under the patent owned by Bayer. The latter is manufactured by the Abbott Laboratories and by H. A. Metz & Co. Its use is increasing. This drug is an effective anesthetic in powder form, and, being insoluble, is only of very low toxicity and therefore can be used safely orally and as a local application. Large quantities are being made into troches and lozenges for the treatment of cough and relief of pharyngeal irritation. It is also being employed in increasingly large quantities in various dusting powders. Anesthesin is a side product in the manufacture of procaine.

New Products

Few realize how much research work has been done in this country by manufacturers of pharmaceutical chemicals during and following the war nor can they understand how great the promise is in this field, providing reasonable protection is given to this industry during the next decade. For instance, "research laboratories are expensive to maintain. It is only through these laboratories that new substances may be discovered which will make America independent of foreign sources of supply." I want to mention a few of the things which have been accomplished by American firms during the last few years.

During the war, Browning and others in England showed that certain dyes, particularly the flavines and brilliant green, had peculiar value as antiseptics. Of these the flavines (acriflavine and proflavine) are the most valuable. The manufacture of these was not undertaken in the United States until after the close of the war. These are now produced by the Heyl Laboratories, the Van Dyk Co., and the Abbott Laboratories. The synthesis of the flavines is exceedingly difficult, involving many steps and great expense in the production on an industrial scale. In spite of its high price acriflavine is being used in increasingly large quantities, particularly in the treatment of gonorrhea for which it has certain well-marked advantages. Recently E. G. Davis, of the University of Nebraska and Johns Hopkins University, has shown that acriflavine, taken internally, is an effective urinary antiseptic. He tested it experimentally in comparison with some 400 other remedies, and found it the best of all those which he tried. It is also being used in a very limited way intravenously for the treatment of various septicemias.

A product somewhat similar in action, and likewise a dye, which has been developed in this country mainly since the war, is mercurochrome, manufactured and sold by Hynson, Westcott & Dunning, of Baltimore. It is also used mainly in the treatment of gonorrhea.

In the field of local anesthetics, Parke, Davis & Co. have produced apothesin, which chemically is the g-diethyl propyl alcohol ester of cinnamic acid. It is giving good satisfaction and already is being widely used.

A substance which has been developed as a local anesthetic is saligenin, which has been brought to the attention of manufacturing chemists and the medical profession by Prof. A. D. Hirschfelder of the University of Minnesota. Chemically it is salicyl alcohol. It is being manufactured by the Calco Chemical Co., and by the Abbott Laboratories.

Benzyl alcohol has likewise been suggested as a local anesthetic, and is being used to a limited degree. This is the work of Prof. David I. Macht, of Johns Hopkins University.

The Abbott Laboratories has introduced a new local anesthetic under the name butyn, which is the sulphate of p-aminobenzoyl gamma-di-n-butylamino propanol. So far as we know, this is the first local anesthetic introduced primarily to replace cocaine. It has the advantage of being at least twice as anesthetic as the latter substance, being more rapid in action, giving more prolonged anesthesia, causing no irritation, being stable on boiling, and being slightly antiseptic, and nonnarcotic. It is the invention of Professors Roger Adams and Oliver Kamm of the University of Illinois and Dr. E. H. Volwiler of the Abbott Laboratories.

Before the war butyn would have been impossible of manufacture because butyl alcohol, one of the most important intermediates in its production, was practically unknown and procurable only at a prohibitive price. It was a curiosity. Its commercial manufacture grew out of the synthetic production of acetone, which was required as a solvent for the making of explosives.

A notable discovery, not distinctly in the synthetic field but yet in a line closely allied to it, was that of thyroxin, the active principle of the thyroid gland. This was made by Dr. E. R. Kendall, of the Mayo Foundation. The prediction is made that this will eventually be made synthetically. This substance is probably much more valuable than anything heretofore known for increasing metabolism in diseases caused by hypothyroidism. It has recently been placed on the market by E. R. Squibb & Co.

A very interesting discovery made by Dr. David I. Macht of Johns Hopkins University, was that benzylbenzoate, a substance heretofore known principally to perfumers, was in reality a powerful antispasmodic. Benzylbenzoate has opened a new field, although it has at times been disappointing in practice, its study has led us into some very interesting research work.

Technical Photographic and Microscopical Society

The Technical Photographic and Miscroscopical Society was fully organized at a meeting held in the Chemists' Club, New York, on Wednesday, May 10. The nucleus of the organization was formed at the annual meeting of the American Paper and Pulp Association last month. Charles F. Roth, who acted as chairman of the meeting, gave an account of the organization work to date and outlined future possibilities. It is planned to hold a general convention of industrial and microscopical photographers in connection with an exhibition of photographic work, chemicals and apparatus to be held on the occasion of the National Exposition of Chemical Industries, September 11-16, 1922.

The following officers were elected:

James McDowell, Sharp & Hamilton Mfg. Co., Boston, president; John H. Graff, The Brown Co., Berlin, N. H., and Bennett Grotta, Atlas Powder Co., Tamaqua, Pa., vice-presidents; Thomas J. Keenan, editor *Paper*, 251 West Nineteenth street, New York, secretary-treasurer. An active committee on membership and publicity was appointed consisting of A. E. Buchanan, chairman; Charles N. Winter, D. H. Killefer, Douglas G. Woolf, Ernest Eberhard, J. A. Scheick, and M. D. Crawford.

The next meeting of the Technical Photographic and Microscopical Society will take place at the Hotel Astor, New York, and be preceded by a luncheon for which a nominal charge will be made. All interested in the development of the new society are urged to get into communication with the secretary at the address given above. The annual dues for membership have been fixed at five dollars.

Dr. Paul M. Giesy, formerly with the Calco Chemical Co., Bound Brook, N. J., is now research chemist with E. R. Squibb & Co., Brooklyn, N. Y.

* *

Dr. R. F. Ruttan, of McGill University, president, Society of Chemical Industry, and Dr. A. T. Charron, chief chemist and director, Dairy School of the Province of Quebec, official delegate of the Canadian Institute of Chemists, will represent Canadian chemists at the 3d meeting, at Lyons, France, on June 27-July 2, of the International Union of Pure and Applied Chemistry.

The Work of the Experimental Kelp-Potash Plant of the Bureau of Soils

By J. W. Turrentine

Scientist-in-Charge, Experimental Kelp-Potash Plant, Bureau of Soils, U. S. Department of Agriculture

Unloading Kelp

THE construction of the experimental kelp-potash plant of the Bureau of Soils, Department of Agriculture, at Summesland, Cal., was begun in February, 1917, the plant was put into operation in August of that year, and the work was terminated in the spring of 1921. It has recently been sold to Rodney Benson for $25,000, as noted in April CHEMICAL AGE. It is understood that operations will be continued along the lines worked on by the Government.

Kelp Products and Processes

During the period of Government ownership, methods of processing kelp were devised, developed and inaugurated as plant-scale processes. Kelp was harvested, dried, subjected to destructive distillation, and leached to remove its water-soluble constituents. The water solution resulting was evaporated for the crystallization and recovery of its values. The charcoal residue was treated to convert it into an active and valuable bleaching agent. The products, potash salts, iodine, and decolorizing carbons, were placed on a full manufacturing basis. The capacity of the plant in all three departments was raised to the basis of 100 tons raw kelp per day. Full cost data covering the various operations were secured.

J. W. TURRENTINE

Scientist in Charge Experimental Kelp Potash Plant Bureau of Soils, U. S. Department of Agriculture

Ammonia, tar derivatives, such as various oils of interesting properties and considerable potential commercial value, creosote and related materials, were shown to be commercially available, and processes developed for their manufacture. With the three products, potash, iodine, and decolorizing carbons, alone, it was shown how even in a small plant such as this, substantial profits are obtainable, and how in a larger plant, built according to plans and using improvements in processes developed here, an industry of size and importance and of great usefulness to the nation can be established. In this way a raw material, large in extent, inexhaustible and totally unutilized, can be made of use, and substantial profits realized.

Potash

The potash, the product around which the original plans were developed and originally the main product produced, was forced into the position of a by-product by the discovery that the charcoal residue remaining after the extraction of potash could by a simple treatment be converted into an active bleaching or decolorizing carbon, useful as a substitute for bone black and as such in demand in a great number of industries. The great value attached to this product gave it first place in the order of consideration. All the energies of the research organization were turned to its development. A process of manufacture was devised and put into practice which made it possible to produce it at a cost which would enable it to bear the main items of expense involved in the entire process of manufacture of kelp products; and, since it came to be considered the main product and so regarded in the computation of cost data, potash and iodine became by-products. This gave potash a very strategic position, indeed, from the point of view of competition with the foreign article. On the basis of cost data as computed here and in a plant large enough to justify the utilization of full-capacity, standard apparatus and labor-saving devices, the decolorizing carbon can be made to carry practically all of the manufacturing costs involved, leaving potash, iodine, ammonia, and other products to carry only the few details of cost involved in their final manipulation. At the same time this will not preclude a profit on the main product, decolorizing carbon.

The potash normally yielded by the simplest process here in vogue is potash of the fertilizer grade, 80% muriate. Its impurities are principally potassium sulfate and sodium chloride. Thus, it is comparable to the best of the fertilizer grades of potash obtainable on the market, is superior to the European product, and is entirely free from all impurities which from any possible fertilizer point of view can be regarded as in the least deleterious.

Since hydrochloric acid is a reagent required for best results in the manufacture of kelpchar, a kelp products plant properly equipped will be provided with facilities for converting the muriate of potash into sulfate with the manufacture of dilute hydrochloric acid for use within the plant. This will not only decrease the cost of manufacturing kelpchar, but will increase the value of the potash and make it available for agricultural use under the most exacting circumstances and particularly in the western markets where the farmers have been prejudiced through propaganda against the use of muriate. This is of advantage, in that long freight haul East will be obviated in part, an objection which can be met through water transportation, since kelp plants from their nature will be situated on the seabord, easily accessible to water transportation.

Experimental Kelp-Potash Plant, Summerland, California

Kelpchar

The decolorizing carbon manufactured from kelp has been applied to a long series of products in a great variety of tests of an experimental, semi-plant, and full plant scale, and has been found to be an especially useful and valuable reagent. It has been marketed under the trade name of "Kelpchar," and as such has won great favor. It has been successfully applied to the bleaching of can and beet sugar, malt syrup, glucose, and syrups from various other sources; organic acids, such as citric, lactic, tartaric, acetic, and malic, glycerine; inorganiz acids, edible and non-edible vegetable and animal oils; various petroleum products; dye intermediates; refined chemicals, pharmaceuticals, and photographic chemicals.

It opens up an entirely new field of engineering chemistry. For the trade it has been manufactured of a grade of activity comparable to that of the best carbons on the market. But a process of manufacture has been inaugurated which makes it easily possible to carry this degree of activity to a much higher point, as demanded, equaling four times that of the best commercial carbon on the market. It is remarkably free filtering, affording rapid filtration and a clear filtrate. It can be prepared as free from water, acid, and oil soluble constituents as can be required by the most exacting market, and its cost of manufacture is such as to guarantee for it successful competition with other carbons of equal activity. It can be reactivated repeatedly and used over and over again, whcih fact must be given full consideration in the computation of cost data involving its use.

Kelp Harvester Loaded with Kelp

Iodine

The iodine produced from kelp easily can be prepared of any grade exacted by the trade and in substantial quantity. For this commodity America is still entirely dependent on foreign sources, principally Chile, although the Japanese have developed a kelp iodine industry which makes it possible for them to export considerable quantities. The fortunes of the iodine industry of Chile are entirely involved in the nitrates industry, and rise and fall with that industry.

Any combination of circumstances which will operate to close down or seriously affect the prosperity of the Chile nitrate industry will deprive the world of its main source of iodine. This is a commodity essential to important American industries of wide application and in the arts and sciences, of which America may be deprived at any time so long as she is dependent on a foreign source. The kelps of the Pacific offer a prompt and satisfactory alleviation of this state of dependence.

Inasmuch as until quite recently America has been dependent on foreign countries for decolorizing carbons also, the kelp industry when carried to its logical development will contribute materially to America's demands for three useful if not essential commodities, decolorizing carbons, potash, and iodine, and to the same degree will contribute to our chemical independence.

Kelpchar Filters

Copper Salts Improve Casein Glue

It has been found that copper salts added to casein glues greatly increase their resistance to moisture and also make them more durable when exposed to the action of molds and fungi. Casein glues containing copper are nearly as moisture resistant as blood albumin glues.

In the preparation of copper-casein glue at the Forest Products Laboratory, 2 to 3 parts by weight of copper chloride or copper sulphate are dissolved in about 30 parts of water and are added to every 500 parts of the ordinary casein, lime, and water glass glue. The copper solution is poured into the glue in a thin stream. The violet-colored lumps formed at first by the coagulation of the glue by the copper solution are reduced by stirring vigorously for about 15 minutes, and a smooth, violet-colored glue results. It is necessary to add the copper salts after the other ingredients are thoroughly mixed, in order to obtain beneficial results. Copper added to the casein before the lime and water glass is ineffective.

Disclosure by the Chemist of Confidential Information

CORRESPONDENCE arising from the editorials in April CHEMICAL AGE, wherein we discussed the disclosure by the chemist of confidential information acquired in the course of his employment, warrants the reproduction of portions of a report of the Legal Committee of the Institute of Chemistry of Great Britain which has to do with the legal aspects of the chemist's relation as an employe.

This subject has direct application to the situation wherein a chemical manufacturer states that distrust of chemists has arisen because of violation of confidence in the use of information acquired in plant experience. According to the report referred to, employers have been held to be warranted in dismissing employes for disclosure of the employers' trade or business secrets, for disclosure of the accounts of a company to a person connected with another company, and for the secret receipt of commissions from companies with whom he contracted as agent for his employers. The courts will restrain, often with damages, the publication to the prejudice of the employer of information acquired during an employe's term of service.

In many of these matters a chemist stands in an exceptionally privileged position for the acquisition of such secret knowledge, and although "a man's aptitude, his skill, his dexterity and his manual or mental ability . . . are not his master's property, they are his own . . ." and, therefore, although he is entitled to the enhanced value of his professional knowledge, no employe is justified in using or publishing knowledge or information as to his employer's business. For instance, a process or a particular piece of apparatus used in a certain factory may actually be described in the literature, but a chemist is not allowed without permission to disclose that this particular process or apparatus is used in the factory where he is or has been employed.

In a similar manner an employe cannot use in a future employment confidential information obtained in the course of his late employment, *i.e.* such information as relates to the business connections, or the secret (unpublished) processes—of his late employer, or the results of (unpublished) researches carried out by himself or his predecessors or immediate colleagues in such employment.

On account of the confidential nature of his employment a chemist is frequently called upon to assent to a covenant restraining his right to practise in a certain branch of the profession, subject to specified limits as to time and place. It must be emphasized that such covenants must be supported by good consideration, and that the restraint must not extend further than is necessary to protect the reasonable rights of the employer in the particular circumstances in question. A covenant of this nature cannot be enforced by an employer who has terminated the contract by wrongful dismissal.

In chemists' contracts it is commonly covenanted that in the event of any improvements or inventions being made by the employe during his term of service they shall be communicated to the employer, and any patents that may be taken out for them shall be the sole and absolute property of the employer. Having regard to the nature of the duties of a scientific and technical employe, such as a chemist, his opportunities and qualifications for getting an insight into confidential matters, and the special knowledge he is properly expected to bring to bear upon his work, these stipulations are, in the great majority of cases, reasonable.

It is difficult to see how any chemist, even if his duties be of a routine character, can fulfil his common-law obligations of diligent and faithful service and of secrecy otherwise than by full disclosure to his employer (and to no one else, except with his employer's permission) of any improvements or inventions he may make. Sometimes it is expressly agreed that the employe is to receive additional, though unspecified, remuneration, at the discretion of the employer, in respect of such of the employe's inventions or the like as are taken up and worked by the employer.

Except in very unusual cases, such as where a chemist is engaged specifically to invent a process for manufacturing a particular material, it is impracticable to specify a definite basis of remuneration, and this matter has to be left to the good sense of the employer, who, as a business man, will naturally be anxious that a chemist who has proved his worth will be contented with his employment. A chemist who has shown originality and ability by making discoveries is generally marked out for special advancement.

It should be borne in mind that even if the service agreement contains no express covenant to give to the employer the benefit of discoveries, etc., made by the employe, there may nevertheless be an implied contract to that effect. Thus in the case of the manager of an engineering company, whose agreement contained no such covenant and who took out certain patents, it was held that owing to the nature of the relations between the parties he was not entitled to the benefit of the patents (*Worthington Pumping Engine Co. v. Moore*). The judge said:

> "I recognize and quite appreciate the principle of those cases which have established that the mere existence of a contract of service does not per se disqualify a servant from taking out a patent for an invention made by him during his term of service . . . but, on the other hand . . . it is clear that the circumstances must be considered in each case. I consider that, bearing in mind the principles laid down in the authorities to which I have referred, it is impossible to say in the present case that the defendant has established the right he claims, having regard to the obligations to be implied arising from his contract of service, and I am of opinion that his case is inconsistent with an observance of that good faith which ought properly to be inferred or implied as an obligation arising from his contract."

The counsel imparted in the above report has added significance to the American industrial chemist in that it represents an aspect of the service of a professional economic organization of chemists to its members, wholly distinct from the functions of a scientific society. It is an example of economic educational service having to do in a vitally important way with the members' material welfare.

The duPont Chemical Co., organized at the close of the World War to take over and dispose of the duPont company's abandoned war plants and excess war materials, has finished its work and is arranging to distribute its assets to stockholders.

Under the plan adopted for the liquidation, stockholders of record at the close of business on May 20, 1922, will be entitled to receive for each share of stock $2.50 in cash, one-eighth of a share of duPont debenture stock, and one share of the stock of the Industrial Salvage Co., organized to take over the remaining assets and liabilities of the chemical company. Net assets are estimated at $1,720,000 or about $2.15 a share. This distribution will amount to something more than $14 a share for duPont Chemical Co. stockholders.

Vitamines and the Future of Margarin Manufacture

By Dr. Casimir Funk

Associate in Biological Chemistry, College of Physicians and Surgeons, Columbia University;
Director, H. A. Metz Research Laboratory

DURING the 11 years in which I have been engaged in research, mostly in the field of vitamines, this is the first occasion that I have addressed a gathering of business men of one of the great food industries on some of the problems of development and production. This occasion augers well for closer cooperation between the practical business man representing industry, and the food industry, essentially chemical, in particular, and the laboratory man, who can help the former and from whom he can learn a great deal.

Of late the margarin industry is distinctly in the vitamine "phase." Being myself a good deal responsible for the development of this branch of nutrition, I am anxious to see what can be done to overcome the difficulties which have arisen just recently, and to consider to what degree the criticisms directed against the use of margarin and allied products are justified.

The product of the margarin industry, I understand, is confronted with two sources of competition, viz., the butter producers and the nut-butter manufacturers. Each claims that its products are superior to margarin on account of the nature of their primary product, being less refined and containing certain elements of nutrition to be referred to later. The development of our knowledge of vitamines has had one undesirable effect, viz., it has enabled a certain school of nutrition to emphasize the value of natural foods, which has found, of course, willing followers among food producers who are more than willing to exploit these ideas to their best advantage. The producers of natural foods avail themselves of class legislation which would permanently cripple and even annihilate the industry of artificially produced foodstuffs.

DR. CASIMIR FUNK.
Associate in Biological Chemistry, College of Physicians and Surgeons, Columbia University, Director, H. A. Metz. Research Laboratory

The idea that we cannot improve food as provided for us by Nature is entirely wrong and reminds one of the idea entertained early in the nineteenth century, that the laboratory would never be able to duplicate organic products as elaborated by Nature in the plant and animal cells. The word "never" does not exist in science. As early as 1827 Wohler synthesized urea, the first natural product made artificially in the laboratory. Since then hundreds of such products have sprung from this fecund source and have proved identical in every respect with the products elaborated by the cell.

The same situation applies to our fats. With increasing knowledge of our nutritive wants, and data being collected with marvellous speed, there is no reason why we cannot compound food mixtures superior in nutritive value to the products provided for us by Nature. You see a very similar situation in the skimmed-milk industry. Its products were fought by the milk-producers on very much the same ground as the butter producers fought margarin, viz., the deficiency of vitamine A. After much effort was spent by the adversaries of the skimmed-milk compounds, a product appeared on the market which contained a certain proportion of cod liver oil. This product has been tested successfully on a number of infants and can be made richer in vitamine A than the original milk. Inasmuch as legislation could not debar such a product on the ground of deficiency in vitamine A, the adversaries of skimmed-milk products will be compelled to find other reasons for its prohibition. If I am not wrong, all the skimmed-milk compounds will be modified in the future in some similar way. This, it seems to me, indicates clearly a future tendency of the margarin industry. Unfortunately in the margarin field direct-feeding experiments are scant, and those bearing upon the vitamine-content practically absent. This is why I shall have to limit myself to somewhat indirect conclusions, based on analagous experimental work.

Value of Margarin as a Fat-Component of the Diet

Whatever may be the source of margarin, its utilization in the body, i. e., its caloric value is equal to that of butter in the physiology of nutrition. We have been unable to detect any difference between the various fats in this respect with margarin in particular. Whether the raw materials of margarin are of plant or animal origin, we are not dealing with fats foreign to the body, as the same fats are a part of our regular diet. Their fate in the body is the same. They are partly split by the pancreatic ferment, steapsin into which their components, glycerol, and fatty acids which are absorbed in the form of soaps by the intestinal wall and form largely the tri-glycerides which can be used or stored up by the body.

The chemical nature of the various fatty acids derived from margarins or butter gives us no reason to believe in any real difference as to their utilization by the body. As a matter of fact, all the edible fats, including margarin, have the same co-efficiency of digestibility, viz., 97-98 per cent, and yield on combustion the same amount of calories. One of the latest text books on dietetics (van Noorden and Salomon) says that margarin when prepared in the proper way from sound ingredients can be used in place of butter. We see from the few words above that nobody can claim any nutritional difference between margarin and butter, from the point of view of its fat nature alone. All criticisms directed against margarin as a food originated from the results of vitamine research. It is this aspect of the

---

*Presented at third annual convention, Institute of Margarin Manufacturers, Detroit, Mich., May 24-25, 1922.

problem that I here wish to emphasize. The new developments of vitamine research are too well known to be dwelt upon here. I shall restrict myself to the vitamine associated with fats, viz., vitamine A, and which has a direct connection with the production and distribution problems of the margarin manufacturers.

Vitamine A

Knowledge of vitamine A has many new and recent developments. Shortly after I had assumed theoretically the existence of a specific antirachitic vitamine in cod liver oil, McCollum, with his collaborators, and simultaneously Osborne and Mendel demonstrated the existence of a vitamine associated with fats, which plays an important role in the nutrition of certain animals and presumably also of man. I say here expressly "certain animals," as recently I have been able to keep adult pigeons for 140 days on a diet free from this vitamine. First it was assumed that vitamine A was associated only with animal fats, particularly butter, egg yolk and cod liver oil, but lately its presence has been demonstrated in a number of plant products, especially green vegetables and also some seeds and roots. Vitamine A has been found to be much more widely distributed than was at first surmised. So much so that in our experimental work we must take great care to free the diets from this admixture. This is done usually by a combination of extraction with fat solvents and submission to the action of air (oxidation) at high temperature.

Even with these precautions the reports from the various laboratories are far from consistent. Some experimenters (Drummond and collaborators) report that on carefully purified diets young rats stopped growing after ten days, whereas Miss Paton and myself are unable to arrest growth completely even after two months and longer. It seems not impossible that besides the variations in the laboratory conditions, various breeds of rats show differences in their vitamine A requirements. As regards the absolute requirements of a rat for vitamine A, we are not informed. It is assumed, however, that 5 per cent of butter in a diet is sufficient, and as a rat of 50-60 grams' weight consumes about 5-6 grams of a standard synthetic fat, this means an equivalent of .25-.30 grams of butter a day.

Similarly, according to Zilva and Miura, the requirements of a rat in terms of cod liver oil vary between 1.7-5 mg. per day. This means that cod liver oil on an average is 100 times as potent as butter. Let us see what this would mean as calculated for a two-year old child (11 kilograms). This would mean 46 grams a day in terms of butter and .36 grams in terms of cod liver oil. Judging from the amount of butter or cream in its diet, a child of two years gets not far from this amount. With rats, the vitamine requirements as regards vitamine A have been found to be materially smaller when the rats approach maturity. From analogy we must surmise that the same facts apply to adult man.

We are entirely in the dark as to what role vitamine A plays in the animal economy. We know that in its absence certain young animals at least cease to grow, but a lack of any essential constituent of food causes a similar result. We know that resistance to infections, particularly of the respiratory organs, is diminished, but this might not be specific for vitamine A. We know only of one apparently specific connection and that is the occurrence of ophthalmia (xerophthalmia) following vitamine A deficiency; this is an eye infection which I will describe a little more in detail.

Ophthalmia

This condition has been described in a number of laboratory animals, and also in children, when placed on a diet deficient in vitamine A. First regarded as a deficiency disease, in the same sense as berberi and scurvy, it doubtless ultimately will be proven to be an unspecific infection of the eyelids and cornea, a sequence of deficiency in vitamine A. What the real connection is between these two phenomena is still unknown; it seems to us that the etiology of ophthalmia requires a good deal of further study, as was emphasized by Walker (Jour. A. M. A. 78, 273—1922) not long ago. Indeed, no pathological changes have so far been detected to justify this sudden invasion of bacteria.

As regards the time necessary for the development of ophthalmia, the available data vary a good deal, most of the investigators reporting the necessary time to be 6-11 weeks for the rats and for dogs almost 100 days. This means that a long continued deficient dietary must be instituted before symptoms manifest themselves. As regards the percentage of the animals so affected, there also is a considerable discrepancy in the available data. While Osborne and Mendel, who have the largest amount of statistical material on rats at their disposal, report 50 per cent of the animals affected by ophthalmia, Emmett reported almost 100 per cent. It seems to me that the cleanliness has something to do with the incidence; when a number of rats are kept together in one cage the incidence seems to be greater than when they are kept separately and cleaner. It is often disappointing when one desires to produce ophthalmia for the purpose of testing fractions obtained from cod liver oil to see the small percentage of animals which finally develop it and also the length of time necessary for this purpose. To summarize our personal experience on the subject, we find that the only definite manifestation of a deficiency in vitamine A, ophthalmia, needs further studies under uniform conditions as regards sanitation, age and breed of animals, and the method of food preparation.

Vitamine A and Rickets

Through the progress made in the last few years in the study of rickets, the problem of vitamine A presents a somewhat changed aspect, especially in connection with the subject of margarin. In accord with my conception that vitamine A has antirachitic properties, and with Mellanby's experimental work on young dogs, milk should be regarded as a food which is able to protect a young animal or a baby from rickets.

However valuable this would be from the standpoint of milk and butter being "the perfect food," modern investigations on rickets have demonstrated clearly that, strange as it seems, milk and butter both are unable to protect a young animal from rickets, while cod liver oils possesses these properties to a very marked degree. At the same time, as we already have seen, cod liver oil contains much more of the substance which is curative for ophthalmia than does butter. Should this phenomenon be interpreted to mean that for curing ophthalmia and for resumption of good nutrition and growth, small quantities of vitamine A suffice, while for prevention of rickets large quantities of the same substance are necessary? Or should it be explained by the existence of a separate antiophthalmia and antirachitic vitamine, as McCullom and his collaborators recently suggested? These questions will be clearly answered only when the two fractions from cod liver oil are separated from each other in a chemical way and tested for both actions Whatever the final outcome of this issue will be, it is important to know that milk fails us in its antirachitic properties, and that we had to hunt for protection by using cod liver oil and other factors, which, however, is not within the scope of our present consideration.

Chemistry of Vitamine A

While the elucidation of the chemical nature of this vitamine, particularly its antirachitic variety, has seemed hitherto very remote, the recent progress made in the methods of testing makes justifiable the hope that the antirachitic vitamine will not remain to us a complete mystery very much longer. It seems to me that the leading food industries can not afford very much longer to relegate vitamine A to a class of mysteries, always to remain as such in the future.

First, in the method described by McCollum, Simmonds, Shipley and Park (Jour. Biol. Chem., 51, 41—1922), we possess means to test for the presence of the antirachitic vitamine. The test is made on rats on a diet containing a low proportion of phosphorous and vitamine A and a high proportion of calcium. After 30-35 days the fraction to be tested is given to the rats daily for five days. After this time the animals are killed and their bones examined for fresh deposition of calcium salts. The test in our hands proved to be entirely reliable. Having this test at our disposal, material advances have been made in the chemistry of the antirachitic vitamine.

The chemistry of antirachitic vitamine was started by the author in 1912 when no physiological methods were available for testing for the presence of this substance. In 1914 McCollum and Davis (Jour. Biol. Chem. 19, 245—1914) saponified butter and extracted the vitamine A with olive oil. This hopeful method was not exploited by the above investigators. While Drummond (Bio. Jour. 13, 81, 1919) failed to achieve success by using the saponification method, Steenbock and his collaborators (Jour. Bio. Chem. 47, 89, 1921) made a very important advance in the same direction. Cod liver oil was found quite stable to saponification with 20 per cent alcoholic potash solution, boiling the mixture for four hours; and what is still more interesting for us, the active substance could be extracted from the soap solution with ether and concentrated in this way.

A more recent paper by Zucker, Pappenheimer and Barnett (Proc. Soc. Exp. Biol. Med. 19, 167, 1922) signifies a further very desirable step in the same direction. Here the fatty acids and cholesterol were separated from the saponified oil and found inactive, while the mother liquor was more active than before. In this way the final fraction could be made as concentrated as desired.

By an entirely different procedure, which will be described in detail in collaboration with Dubin in the near future, we have obtained the antirachitic vitamine a hundred times more concentrated as compared with the original starting material. Besides the scientific interest and the well founded hope to get at the chemical nature of this vitamine in the near future, the practical application of this very substantial advance is obvious to all of you. It remains to be investigated how long these concentrated preparations will remain active; but if they do, the problem of making food products deficient in vitamine A richer in this substance, is practically solved.

Vitamine A-Content of Various Margarins

It is regrettable that we possess hardly any scientific data on this, at least theoretically, if not practically, important subject. Besides the fact, shown by Osborne and Mendel (Jour. Bio. Chem., 20, 379, 1915) that the oleo-portion of the beef fat contains all the vitamine A, while the solid portion is deficient in it, and the investigation of Halliburton and Drummond (Jour. Phsyiol., 51, 235, 1917) who made a more thorough investigation, not many data are available. Unfortunately these latter workers, while stating the source of the products, did not mention at all the way they were manufactured. Their results were as follows: Margarins of animal origin were found to contain vitamine A. Margarin of plant origin did not permit normal growth but prevented ophthalmia. Nut butters were usually also deficient. Lard substitutes made from hydrogenated vegetable oils also were found to be deficient.

It must be borne in mind that these results are based upon English margarin which under the existing law may contain as high as 10 per cent of butter, and might, therefore, give better results due to the presence of this admixture.

It is self-evident that in each margarin factory the vitamine A-content of the finished product will vary, and has to be determined specially in each case. The vitamine-content of the finished product will depend on the vitamine-content of the raw materials, the amount of milk constituents in it and the method of manufacture. For instance, it has been shown repeatedly that the aeration of the food, especially in conjunction with heating, is detrimental to vitamine A. This has been shown for lard by Drummond, Golding, Zilva and Coward (Bio. Chem. Jour. 14, 742, 1920), viz., that the method of rendering the lard is of significance for the vitamine A-content of the finished product. This also is in accordance with the statement of Daniels and Loughlin (Jour. Biol. Chem. 42, 359, 1920) who have found that some samples of lard contained a noticeable amount of this vitamine. Heating and simultaneous oxidation is the method used in the laboratories for rendering the ingredients of the basal diet free from vitamine A.

All that I have said here can be applied in the practical procedure of margarin manufacture. It is quite probable that most of the natural foods contain some vitamine A which could be preserved by taking proper precautions. While hydrogenated foods are regarded at present as vitamine-free, the present method of hydrogenation involves high temperatures, and it should be worth while to investigate whether or not a cheap method of hydrogenating oils could be devised which proceeds at low temperature and which would be not so destructive to the vitamine. In margarin manufacture a mixture could be selected to include a food ingredient with a naturally higher vitamine-content of the type of oleo. Finally, by eliminating the destructive factors, the original vitamine-content could be more efficiently preserved.

Practical Dietetic Aspects of Margarin

In considering the nutritive value of margarin, we naturally have to compare it with butter. Since the discovery that fresh milk, cream and even butter display only an insignificant antirachitic potency, the dietetic position of margarin has been strengthened materially, since in this respect no noticeable difference has been established. On the other hand, the necessity of laws in all countries regulating the total solids and fat-content of milk, shows conclusively that not all milk producers are concerned particularly with the health of our babies. In this respect we are protected fully, but a new problem has come up which requires in our opinion new legislation. This is the logical postulate first suggested by us and now experimentally fully confirmed. We are speaking here of the dependence of the vitamine-content of milk on the vitamine-content of the feed of the cow. At the present time probably most of the winter milks are decidedly lower in vitamine value as compared with summer milks; we can conceive, theoretically at least, the possibility of milk and butter being almost entirely vitamine-free. As Kennedy and Dutcher (Jour. Biol. Chem. 50, 339, 1922) have lately demonstrated, the winter milks by a suitable choice of feed could be rendered as nutritious as summer milks and on such selection we should insist. The vitamine-content of the marketed milk should be tested by the authorities and rapid methods for such tests should be devised.

The margarins are not a substitute for milk, but a substitute for butter and as such have fulfilled well the requirements, except for deficiency in vitamine A, which as yet is not accurately determined. This vitamine, according to our present knowledge obtained from experiments on rats, is required more by the young, growing animal, than later in life. Judging from the occurrence of ophthalmia in children, when their diet is limited to highly skimmed milk as a source of vitamine, the human requirements for vitamine A seem to be analogous to those found for rats.

The paucity of ophthalmia cases in central Europe during the war shows us that even in times of serious deficiency of fats, the human organism, especially adults on mixed diet, can quite easily limit this deficiency. In children still on a one-sided diet, replacing butter by margarin of the present type may not be always always desirable unless the diet is supplemented by a product rich in vitamine A, like fresh green vegetables, eggs or cod liver oil. With adults, on the contrary, for whom the requirements of vitamine-content are smaller, the use of margarin has no dangers of deficiency. Any of the existing text books on vitamines will give you a long list of foodstuffs which enter into everybody's dietary and which more than offset the partial deficiency of margarin. For cooking purposes, while no actual experiments are available on this point, it seems to us that margarin safely could replace butter. In frying and cooking it is likely that the vitamine A content of butter is for the most part destroyed by oxidation and may possess no advantage over margarin.

Outlook of the Margarin Industry From the Vitamine Standpoint

The margarins, as we already have seen, are fully equal in nutritive value as regard their content in fats and the number of calories the yield, to butter and nut butters. From the standpoint of our present knowledge of nutrition, you can safely proceed as you have done successfully in the past, but if you wish you could disarm entirely your opponents. Margarin differs from butter only in its diminished content of vitamine A. This seems to us the only scientific ground on which legislation adverse to the development of margarin manufacture could be attempted. In spite of the fact that such legislation for reasons already explained, does not find justification in our eyes, this problem seems sufficiently important to the trade association of margarine manufacturers to invite a vitamine expert to address its convention. If I am right in this assumption nothing seems easier to me than to restore or supplement the deficient vitamine. As I have stated above a better selection of raw materials and [illegible] injury [illegible] selection of raw material and avoiding injury of the sensitive vitamine A will remove partially the difficulty. How far this is possible with your present processes of manufacture, I cannot state. To go a step further, you can make your margarin as rich or richer in vitamine A than butter is. I have here in mind the addition of a small amount of cod liver oil. The product thus improved would have a distinct advantage over butter in that it would be antirachitic as well as antiophthalmic.

A certain amount of experimentation on this subject appears to be necessary, but judging from the requirements of rats for butter as compared with cod liver oil, .36 gram of the latter is equivalent in value to 46 gram of butter. This means that to a pound of margarin 3-4 grams of cod liver oil would have to be added or 40 mgr. of the concentrated vitamine fraction which has been obtained from the oil. This later addition would constitute only one hundredth of 1 per cent. of your finished margarin.

Millions of pounds of margarin sold yearly to the public perhaps may not show you the desirability of any further improvements in your manufacturing processes, but to my mind, the exploitation of the vitamine doctrine of your not always fair competitors renders a new step in the development of your industry very timely. It must be the task of the laboratory workers in nutrition to help the food industry to improve the existing food products to the best of our knowledge for the benefit of the present and future generations.

German Research and Appeals for American Aid

Bowdoin College, Office of the President

EDITOR CHEMICAL AGE:

In reply to an appeal to the American universities, schools, museums and science societies sent from Tubingen, Germany, opening with the words "German culture," containing no statement of any sort of national regret for the war, and asking American science institutions to help to carry on research work in Germany, the following letter was sent:

"I have received an appeal to the American universities signed by you and asking for aid for the scientific work of German schools, institutes and universities.

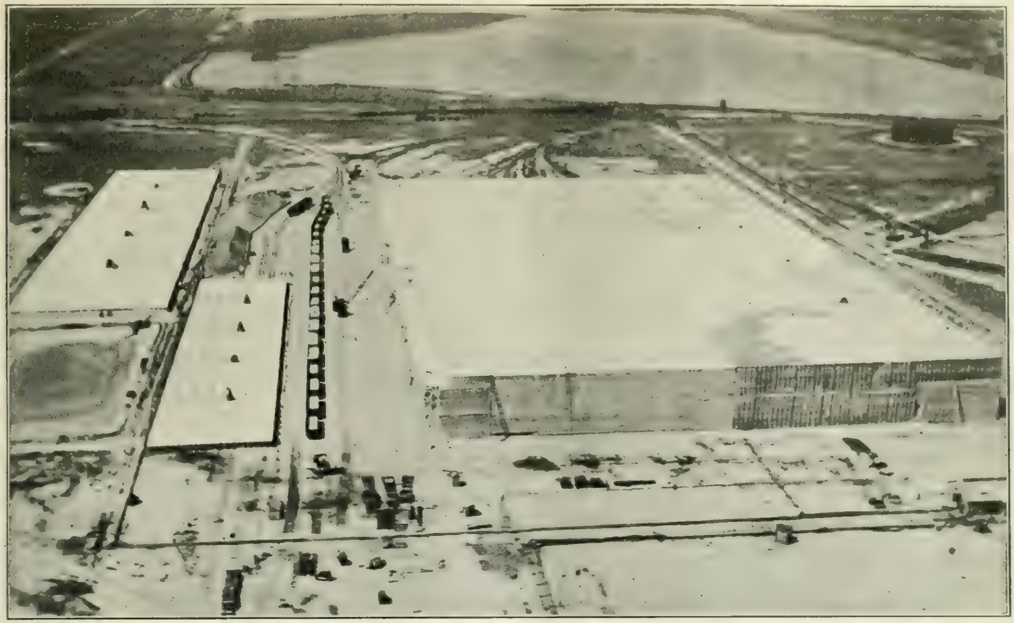
"I desire to say that at the present time I do not intend to ask our college or the members of our Faculty to contribute to this cause. I feel that intellectual Germany has not yet made restitution for the harm that it did the world in advocating war in 1914, and until there is some sign that the scientists and scholars of Germany feel some sense of repentance for the woe which their country has brought on the world, both personally and officially, I desire to have no part in a movement that seeks to support German culture and German science.

"I am proud of the name of 'scholar,' and I believe there should be proper relations between scholars in all parts of the world; but those relations must be based on respect. When the scholars and scientists of Germany show the rest of the world that they are genuinely sorry for what their country has done in the past, there will be a different attitude in many circles over here. But until there is such a feeling many Americans care to have nothing further to do with German universities, German scientists or German scholars."

KENNETH C. M. SILLS

Brunswick, Me., May 18, 1922

E. J. Helgren, Santa Rosa, Calif., has developed a prune syrup in whose manufacture surplus small and [illegible] prunes can be used to produce a commodity equal to maple syrup or its compounds. Mr. Helgren states that 1 ton of prunes will make 100-125 gallons of syrup containing all the wholesome and medicinal properties of the prune and miscible in all proportions with glucose.



Stock Piles, Texas Gulf Sulphur Company. On the Left Are Two Bins Being Filled, with Projecting Cones of Sulphur Formed Above the Surface of the Contents by Solidification of the Molten Sulphur Discharged from Elevated Pipes Progressively Raised as the Bin Is Filled

Sulphur and Pyrites Production

SULPHUR production in 1920, 1,255,249 long tons, was the largest in any year except 1918, when the output reached 1,353,525 long tons. Shipments in 1920, amounting to 1,517,625 long tons, exceeded those of any other year. Two mines in Texas (Freeport Sulphur Co., Texas Gulf Sulphur Co.) and one each in Louisiana (Union Sulphur Co.), and Nevada (Nevada Sulphur Co.) furnished all the sulphur produced in this country in 1920. The value of the shipments in 1920 is estimated at $30,000,000.

The sulphur produced in 1921 amounted to 1,879,150 long tons, which is about one-third more than was produced in 1920. On the other hand, the shipments in 1921 were nearly one-third less than in 1920, amounting to only 954,344 long tons, as against 1,517,625 long tons. It is therefore evident that large stocks of sulphur are now on hand. Two mines in Texas and one each in Colorado, Louisiana, Nevada, and Utah contributed to the output in 1921. In 1920 and 1921, as in former years, more than 99½ per cent. of the sulphur produced in this country came from mines in Texas and Louisiana, whose output makes this region the world's chief source of sulphur and empowers the producers to dominate the sulphur markets of the world.

The exports of sulphur in 1920 amounted to 477,450 long tons, valued at $8,994,350, and in 1921 to 285,762 long tons, valued at $4,524,788. It is therefore apparent that the exports of sulphur decreased about two-fifths in 1921 and that there was a drop in value of $3 a ton from 1920 to 1921. The imports of sulphur dropped from 136 long tons in 1920 to 50 long tons in 1921, and the value decreased about $7.50 per long ton.

Pyrites

Production of pyrites in 1920 was 310,777 long tons, valued at approximately $1,597,000. This quantity was almost twice that produced in 1921, 157,118 long tons, estimated to be worth about $700,000. In 1920 California led in production, contributing 128,114 long tons, which was only a few hundred tons less than in 1919, and 98,252 long tons in 1921. The average value per ton for the total pyrites produced in the United States was somewhat less in 1921 than in 1920, being about $5 for 1920 and $4.45 for 1921.

Reports received from producers indicate that the market for pyrites has been very poor for the last two years, because the manufacturers of sulphuric acid, who have heretofore been the principal purchasers of pyrites, are now using more native sulphur, which is not only cheaper but more easily handled. The slack market is also reflected in the imports of pyrites, which fell off about one-third in 1921 from those in 1920. The imports in 1920 amounted to 332,606 long tons, valued at $1,660,832. About 200,000 long tons came from Spain, 100,000 long tons from Canada, and small quantities from France, Cuba, Chile, and Hongkong. The imports in 1921 amounted to 216,229 long tons, valued at $818,852. The price per ton of the imported ore was about $1 less in 1921 than in 1920.

Transportation is a determining factor in the use of pyrites; another factor of increasing influence on sulphur prices is the by-product acid of fume-recovery processes in smelter operations.

The accompanying aerial photograph of the stock piles of the Texas Gulf Sulphur Co. enables one to visualize a domestic situation that not only has displaced Sicily as the world's chief source of sulphur, but which outstrips pyrites as an economical raw material in sulphur acid manufacture.

The Material Welfare of the Chemist

Commendation of Otto Eisenschiml. Importance of the Subject Demands Continued Discussion

By C. H. Christman

Research Chemist, Clinton Corn Syrup Refining Co.

I HAVE read with great interest the articles and editorials in CHEMICAL AGE on economic aspects of the practice of chemistry and am positive that their stimulating impression is shared by many chemists. I have heard discussions upon similar topics in which Mr. Eisenschiml has participated. Regardless of whether one agrees with him or not I feel that chemists owe much to a man who has the temerity to induce discussions such as the ones in your columns.

Too often I have found that the chemist has simply accepted his surroundings as inevitable, and the boundaries surrounding himself as insurmountable. This is most unfortunate, but in many instances the fault lies in the man himself. I am partly convinced that many such cases represent the saying, "A little learning is a dangerous thing." The chemist often does not have a thorough knowledge of chemistry and is not fitted to hold the position which he occupies.

I agree with Dr. Stieglitz and those who consider the undergraduate work as only the bare foundation for a chemical training. This should be followed by more intensive work which furnishes a broad and more competent view of the science so that the worker finally attains the plane where he can labor constructively. True it is that many cannot pursue post-graduate work, but this is not an absolute prerequisite. The same advancement can be made in the industries, if one has the proper foundation and sufficient incentive.

It would be far better for the profession as a whole if the science of chemistry could be presented in some educational institution only for its educational merits. These schools should not attempt to train professional men, because of the lack of proper staffs and equipment. I have seen many men who consider themselves chemists, because they had made an acquaintance with the science, taken all the course offered and received a degree from such an institution. This type of chemist-training is more harmful to the profession than an over-supply of well-trained men could ever be.

I cannot agree that the chemist should occupy such a position as the lawyer or the doctor. The very nature of the professions is such that our profession has a different sphere—we serve industries, rather than the individual directly. However, as a scientific worker the chemist should possess a class consciousness. The recognition due the chemist has been received in part, but the mushroom growth fostered by the war has not been long retained. The rank and file of the profession has yet to establish itself. The very character of our work makes this a difficult task, since only the explorers, the fortunate discoverers of useful products and the more versatile received widespread recognition. So long as the routine man, well trained though he may be, does not receive his share of the recognition due chemists, just so long will the profession fall short of the place it should occupy.

An army moves only as fast as its slowest unit. The slow moving part of our profession is laggard and it behooves those who can and will to urge on and devise the means by which they may best advance. I am sure that a distinction must be made and it should be of such a character that the new body represents those who are giving something to the profession. The distinction should be pronounced and the goal sought one which would serve to draw into its ranks, the real workers in chemistry.

The recent action of the American Chemical Society in creating a development committee, indicates that much thought is being given to the conditions surrounding the welfare of chemists. It may be that such suggestions as you make will be developed satisfactorily. The time seems to demand such action, the need is sufficient and I wish to express my appreciation of the stand of CHEMICAL AGE. The discussion which you have inaugurated certainly should continue.

Acid-Proof Varnish

Leon McCulloch of the Westinghouse Electric & Mfg. Co. has found that the addition of a small amount of paraffin or a paraffin-like wax to a varnish, which is, in itself, resistant to water, acid fumes and alkalis, will render the varnish considerably more resistant to them. This is particularly true of baking asphalt varnishes, such as asphalt baking japan and is attributed to the fact that the paraffin, on baking, fills all the pores of the varnish films, and perhaps, also, itself forms a very thin film over the varnish.

All varnish, japan and enamel films are quite readily permeable to water and when immersed in water, soften or swell up and so tend to loosen from the surfaces to which they are applied. For instance, a film formed of a certain black baking enamel permitted passage of 0.002 grams of water per square centimeter in twenty-four hours. Another film formed of the same enamel, after the addition of a wax, in this instance ceresin, permitted the passage of only 0.00005 grams of water per square centimeter in twenty-four hours.

Mr. McCulloch made a number of comparison tests of the resistance of cotton fabrics, coated with various varnishes and enamels, to nitric and sulfuric acids and found that the addition of paraffin, or other equivalent waxes, to the varnishes and enamels employed greatly increases the resistance, endurance and life of the coated fabric.

Various waxes, other than paraffin, may be employed such as ozocerite, ceresin, petrolatum, halgenated naphthalenes such as halowax including the mono-di-tro- and tetra-chloro-naphthalenes, etc., together with various solvents, such as benzine, turpentine, benzol, or in fact any varnish solvent.

It may be noted that the addition of the small amount of wax necessary to produce suitable results has no appreciable effect upon the harshness, toughness, appearance and other desirable quality of the varnish, japan or enamel, other than to give to them a slightly waxy surface or "feel."

One composition which Mr. McCulloch found extremely efficient, and which he mentions in U. S. Letters patent No. 1,411,050, comprises: Asphalt baking japan, 1 gallon; paraffin, ½ pound, in solution in 1 gallon of benzine.

In forming this composition the paraffin is dissolved in the benzine and the varnish is thinned with the resultant solution.

Mid-West Opinion on the Formation of An Economic Organization of Chemists

By Otto Eisenschiml

Manager, Scientific Oil Compounding Co.; President, Chicago Chemists' Club

THE American Institute of Chemistry marks a new departure which ought to commend itself to the serious attention of all those interested in the welfare of chemically trained men. Whether or not it is a desirable departure, presents a point that need not be discussed now, inasmuch as the departure has been made; whether it will last or not, the future will show. If it brings with it such benefits to its members, and incidentally to the whole profession, as its promoters wish it will outlast all criticism. If its usefulness should not become apparent, it will gradually die of its own accord.

In August, 1921, CHEMICAL AGE published an outline of conditions in the chemical profession in England half a century ago, and of the steps that led to the founding of the Institute of Chemistry of Great Britain and Ireland. It is claimed that conditions today in American Chemistry are analogous, and that the establishment of a similar organization in the United States is a matter of urgent necessity. English chemists, prominent at the time in the Chemical Society of London, opposed the idea of the Institute but later admitted that a scientific society should not burden itself with questions of material welfare pertaining to its own members.

It is exceedingly doubtful that a good analogous case exists, considering the conditions that gave birth to the English organization. In Great Britain, the chemists of that era were fighting for recognition of a new and unknown profession and trying to ward off amateurs that were waging a price-cutting war. No such condition exists in America today. Chemists have been advertised with great abandon, enjoy the full respect of the community and lack just one thing, viz., chance to make a fair living.

Any concerted action undertaken by chemists today whether through an existing scientific body or through such new organization as the American Institute of Chemistry must be undertaken with the one point in view, viz., that lack of a decent income is the root of the evil to be fought. To my mind, this is not at all plainly set forth in the literature available on the Institute at this time. Take, for instance, the article in the March issue of CHEMICAL AGE, in which the purposes of this organization briefly are set forth. "Chemical industry," it says, "progresses only as its personnel develops. Helping the individual is the most effective way to help industry."

Why on earth help industry? Is a body of men consisting of teachers, students, production chemists and business managers going to devote its time to help industry? The same industry that has ruthlessly shut down laboratories, broken faith with chemists and never said one single word about helping them? Again, "It is desirable to receive into membership the graduate chemist and to place him. . . where his native ability and acquired talent may gain full expression." Why not say "fullest compensation?" Why beat around the bush? Is the receiving of compensation a disgrace whenever chemists are on the receiving end?

CHEMICAL AGE quite properly says "the purpose of a manufacturing organization is to make money." Chemists' minds, ideals and bodies are starving for the want of money; yet no one seems to have the nerve to ever use the word outright, and even the new Institute shrinks from admitting that the making of money is a legitimate and laudable desire, except for a manufacturing organization.

CHEMICAL AGE says that "the primary purpose of the American Institute of Chemistry is to increase the resourcefulness of men of this type, for thereby is industry helped directly and effectively. . ." Again our poor industry must be helped. Can chemists never come down to brass tacks? Here is an organization newly founded and dedicated entirely to the promotion of economic welfare of chemists, and the first thing it sets out to do is to help the industry that has done its best to make hobos out of them.

So far as the purposes of the Institute are set forth in its constitution and by-laws, I must confess that none of them seem to strike a vital point, although much is left for future consideration. So long as no decisive steps are being taken to stop the endless flow of new graduates, it will be hard to build up a permanent bull market for chemical services; but to undertake steps in that direction does not seem to be contemplated by the Institute. On the other hand, no special organization seems necessary to take such action. The way to get a bunch of friends together to see a ball game, is to put them on a car and go to the park. There is no necessity of forming a club and electing presidents or financial secretaries.

The statement* that an existing chemical organization such as the American Chemical Society cannot embrace any new sort of activity needs to be proven to be convincing. For those seeking precedents, the last few years will furnish plenty of ammunition. Those claiming that the society could not do it, will have to reckon with the fact that it did do it. That this outburst of political and promotional activity was not intended for the benefit of chemists but for one particular industry, is characteristic, but does not refute the argument. The non-scientific activity was there, even if goal and results were equally disappointing.

No society is stronger than its constituents, and the Institute of Chemistry must necessarily draw its recruits more or less from the same material that makes up the membership of the American Chemical Society. As a fair observer of chemists as I meet them from day to day, I believe that they lack about everything that is necessary to guard their own self-interest, including the will to do so. Whether or not a new organization with wide-awake leadership can bring out qualities that are possibly only dormant now remains to be seen.

In the meantime, every well-wisher of chemists, no matter if convinced of the new Institute's necessity or not, ought to assume at least an attitude of friendly interest towards it and should abstain from any action that might impede its progress in any way.

Notwithstanding the doubt expressed in CHEMICAL AGE (April, 1922, page 177), I still believe that times of extreme depression or prosperity are not conducive to a calm deliberation of economic problems. The present state of unemployment will in all probability improve by summer and may altogether disappear by fall. Does this eliminate the necessity of providing steps for similar future contingencies? By no means. But some of those who now complain loudest will be the most confident when the pendulum swings the other way. Critical times have a bearing on the popularity of an idea, but not on the justice of it. If anyone experienced a jolt by my statement that the worst time to remedy an evil is when it is most rampant, I beg his pardon for being under the impression that I was talking to a community of thinking men.

---

* March CHEMICAL AGE, 1922, p. [illegible] "(The American Institute of Chemistry) complements and correlates the functions of the American Chemical Society as our scientific organization. It not only would relieve it, as properly it should be relieved, of attempted functions illy performed, but would permit its undistracted devotion to needed and commendable scientific educational service., —*Editor*, CHEMICAL AGE.

That the American Chemical Society cannot be run by a majority of its own members, is still to be demonstrated. I fail to see the logic in the statement in the article just referred to that "the interests favored by a buyer's market for chemical service cannot be eliminated from the control of the Society in view of the importance of the Society's work in the progress of the science and art of chemistry." To use the vernacular, I fail to see why members of the American Chemical Society cannot be interested in chemical science, weather forecasts and football scores all at the same time. The impracticability of the cultivation of class consciousness in the American Chemical Society is something I most assuredly do not agree to.

I am inclined to protest at the severity of CHEMICAL AGE's consideration of my "feasible plans for improvement." After saying on page 177 that I "show a grasp of economic law and the futility of artifice," it states on page 179, April issue, that I "relegate the whole matter to the law of supply and demand and therefore do not present a single constructive suggestion for the waste incident to its operation."

I am sure I will be excused for saying that if the regulation of the number of chemical students cannot be reconciled with the positon of the American Chemical Society, then by all means let us change the position of the American Chemtcal Society. As to the waste entailed in letting a chemical graduate find employment outside of chemistry, "misdirected academic activity," I fail to see any such waste. Judging things from that angle, it would be waste for a chemist to know geography and trigonometry, or anything else not in daily use.

If academic activity serves only to impart specific knowledge of facts and does not breed a broader philosophy of life, ability to think straight and ambition for some sort of a goal worth while, then it is misdirected activity indeed. The transplanting of chemists into commercial fields, far from involving a waste, would be the greatest factor in eliminating waste that anyone could wish for.

* * *

Dr. Redman's Opinion

Dr. Redman, president of the Redmanol Chemical Products Co., in an editorial in May CHEMICAL BULLETIN, in which he discusses the subject of reorganization of the American Chemical Society, says that among the various matters which the committee should consider is one which it is believed is of fundamental importance, viz., the establishment of proper requirements for membership in the Society.

As a profession, chemists probably spend more time in bewailing the lack of recognition accorded them by the public generally than does any other profession. How much of this is due to the lack of any standards of training or accomplishment which one must attain to become recognized as a chemist by the only existing professional organization of chemists it is, of course, hard to estimate. THE CHEMICAL BULLETIN is strongly of the opinion, however, that the adoption of an official definition of the term "chemist," together with the establishment of definite, if not rigid, requirements for admission into the American Chemical Society, would be a very practical step in the direction of elevating the profession in the mind of the public.

Now is a good time for the Society to decide whether it is a publishing house whose membership, like that of the National Geographical Society, is open to any one sufficiently interested in the subject of chemistry to subscribe for its publications, or whether it is a professional association like the American Medical Association, whose membership is limited to those who have achieved a definite status as a result of either training or e xperience.

* * *

Comment of Chemical Age

To those who have familiarized themselves with the history of chemical segregation the play of opinion on the subject now uppermost in the minds of American industrial chemists is singularly identical with that in England which preceded and attended the formation of the Institute of Chemistry of Great Britain. One school believed that all the problems affecting the practitioner of chemistry could and should be worked out in a single organization of embracing and popular membership subject to one centralized management. This school felt that such system of government was essential to the end that the funds might be available to carry on its publication enterprises with the educational functions flowing therefrom. What difference does it make who belongs to the Chemical Society of London, so long as the money comes to facilitate the program of the management?

A school, touched with a vision of the place of chemistry in industry, in notwithstanding what we today would consider primitive industrial conditions, believed, in conformity with the intellectual revolution wrought by Darwin and his contemporaries, that the economic conditions affecting the trained chemist of that day demanded such segregation as would reflect specialization of function and coordination of parts, under management responsive to the aspirations of its members. They breathed equal loyalty to the scientific society and to the economic organization which was quite in contrast to the *verboten* atmosphere of the former group which needed money for publication projects and fancied the destruction of their plans in any division of interest. They put management above men and believed apparently that only a select few could be trusted with the ark of the covenant.

The formation of the Institute of Chemistry of Great Britain and its service to English chemists are eloquent of the narrow vision of those who antagonized it in the mistaken belief that a single all-embracing bureaucracy could give form and substance to the material aspirations of English chemists. In later years only few had the character to admit that they were wrong.

How Chemists Divide Today

Every alert industrial chemist and the majority of teachers of chemistry appreciate the need of a professional organization of chemically trained men, devoted solely, and without the burden of publication enterprises, to the study of economic conditions as they affect its members and to the wielding of organized opinion in their amelioration or eradication.

One school believes that this function, which demands the sole study of great, dominating groups in many other professions, can be worked with general satisfaction within the confines of the American Chemical Society and as an added responsibility to its omnibus organization.

This school believes that, with the consciousness of chemists aroused, they will be able to convert the American Chemical Society into an organization responsive to their purposes, without any detraction from its scientific and educational service to American industry. They feel that a separate, professional organization is unnecessary so long as they can capture the machinery of government of the scientific society that welcomes membership from all and sundry who have $15.00. They nurse projects of classification of membership within the scientific society already suffering from molecular instability which under the pressure of economic needs "cracks" into simpler, more stable organizations. To preserve the system requires all the ingenuity of spellbinders and politicians.

A school, touched with the instinct of service to their kind rather than to a system and which has learned the value of that service because of its absence when they needed it and who see the futility of seeking it in the bureaucracy of "one big union" dominated by a class, feel that the American Chemical Society should be supported for its educational service and should be protected from the distraction of adsorption of functions absolutely incompatible in practical operation with its purposes.

This school sharply differentiates between the acceleration of chemical education and the multiplication of chemists, consistent with the purposes of an educational society, and the standardization of capacity in industry and the protection and promotion of the interests of qualified practitioners of chemistry, beset increasingly with untoward economic conditions, regardless of the rise and fall of industrial activity; all of which concerns the distinctively economic professional organization.

This school sees the need, in the teaching, industrial and commercial activities of chemically trained men, of an organization, nation-wide in its operation and limited in its local self-government to state boundaries, which will be the servant of its members and whose machinery will run for their respective and aggregate material benefit.

This school does not emphasize wage, pay, or perquisite as the cornerstone of the structure of an economic professional organization. It knows from practical experience that each man must work out his own salvation, that capacity is the sole test of recognition, and that the individual progresses only to the degree that he promotes his organization.

The soundness of its principles, their general commendation and reception by the industrial chemist, regardless of whether times are good or bad, and its loyalty to the educational service of the American Chemical Society, give to this school the sanction of precedent, of present and future need and the assurance of success, in its project of the American Institute of Chemistry as a professional economic organization of exclusively chemically trained men, separate and distinct from but complementing the service of the American Chemical Society.

Current Chemical Patents and Patent Problems

By Lloyd Van Doren, Ph. D.

Consulting Chemist; Patent Attorney, The Chemical Foundation, Inc.

THE revival of the Patent Convention of 1909 with Germany, as of May 8, at once raises a pertinent question as to its effect upon the American chemical industry. Undoubtedly the revival of this convention will be of material benefit to our mechanical industries, but the way is now open for a throttling of the American chemical industry by the Germans through the taking out of numerous product patents, and the non-working of these patents in this country.

While our organic chemical industry has made remarkable strides within the past few years, and while it is the sincere belief of all familiar with its past activities that the American chemist can in time equal and even surpass what has been done by the German chemists, nevertheless unless sufficient opportunity is granted for the acquiring of the basic technical knowledge necessary to accomplish this result, it will not avail the American chemist to proceed with elaborate researches, since he is most apt to find upon attempting to protect the same by patents, that protection already has been granted to citizens of a foreign country.

There is a possible saving factor connected with the revival of the convention, in that it was stated by the Secretary of State that it was necessary to revive the convention in order not to seriously jeopardize American patent rights and interests in Germany, and that the convention could be modified by subsequent legislation by Congress, such as is contemplated in the Stanley Bill, or the treaty as at present written could be denounced and a modification of it obtained by negotiation.

Such a plan of action, it is believed, will be necessary in order to guarantee continued and increased activity in our chemical industry, for otherwise there would be a very natural lack of incentive to proceed with the development of new chemicals for it simply would devolve into what may be termed a game of "beat the other fellow to it." A remedy for this condition appears to have been presented by Senator Stanley in his new bill amending the present patent statutes, which new bill states in part:

> "That two years after the issuance of any United States' patent or at any time after the expiration of that period, if it is shown that the invention covered by such patent is being worked in a substantial manner in a foreign country, and that the owner thereof has failed to work it in the United States, and has refused or refuses to grant licenses thereunder upon such reasonable terms and conditions, etc., etc.

It is to be noted that the requirement for working within two years after the issuance of a patent is predicated entirely upon the fact that the patent shall be worked in a substantial manner in a foreign country. The objection as to hardship upon the American manufacturer is, therefore, done away with since such manufacturer would not have to work a patent unless he were working it in a foreign country, and then the justice of the working in his own country is perfectly clear. It prevents a foreign manufacturer from manufacturing products, covered by United States patents, in his own country, and then shipping such products to the United States and placing them upon the market at prices at which an American manufacturer could not compete, and, in the absence of competition, at prices yielding the foreign manufacturer a very rosy profit.

That such conditions did prevail has not been forgotten, and it is to be hoped that legislation either in the form of the Stanley Bill, or some other measure looking to the accomplishment of the same result will be enacted to protect an industry which is of fundamental importance to the country.

* * *

Titanium Composite Pigments.

The production of composite titanium oxide products which are useful as pigments in the manufacture of paint, rubber, linoleum, plastics, etc., which comprise titanium bodies adherent to and coalesced with a suitable carrier, is the subject of Patent No. 1,409,648, to Louis E. Barton, assignor to Titanium Pigment Co., Inc.

The method of making such composite titanium oxide products comprises the following steps, viz: first obtaining barium sulphate by precipitation in an alkaline solution, next, adding the barium sulphate to a titanium sulphate solution; heating the solution to precipitation of basic titanium sulphate; withdrawing the resulting mixture of sulphates, and calcining it.

Purification of Recovered Zinc Salts.

A process for purifying solutions of zinc salts, such as zinc sulphate chloride, from salts of other metals, particularly iron and metals which are electro-negative to zinc, is shown in Patent No. 1,409,727 to Emanuel Kardos, assignor to Metal & Thermit Corp., according to which process the crude zinc sulphate or chloride solution, which may be the product of a degalvanizing process, or any of the other well known processes which yield one or the other of the salts mentioned, is heated and the iron oxidized by any known commercial process, e. g., by the addition of potassium or sodium chlorate, chlorine or other oxidizing medium; after which galvanized scrap or zinc-coated iron is immersed in the solution, with the result that the acid liberated during the oxidizing reaction unites with the zinc from the scrap, in accordance with the following reaction:

$$2FeSO_4+NaClO_3+3H_2O+2Zn=2Fe(OH)_3+2ZnSO_4+NaCl$$

The solution is kept boiling with the zinc scrap therein until the solution is rendered basic, when the entire iron content will have been precipitated.

Recovery of H_2SO_4 Used in Oil Refining.

A procedure for the recovery of sulphuric acid in a high state of concentration from sludges obtained in oil refining, as well as to recover the reagent which is employed to separate the acid from the sludge, is the subject of Patent No. 1,409,590 to Frederick Salathe, assignor partially to the Western Gas Construction Co., of Fort Wayne.

The process consists in agitating a proportion of the sludge with a substantially equal proportion of hydrocarbon solvent to liberate acid having a specific gravity of about 50-60° Baumé; then allowing the acid to settle out from the mixture and recovering such acid; then mixing a neutralizing agent with the sludge solution to neutralize the residual acidity; then removing the neutralizing agent from the sludge solution; and then subjecting the sludge solution to distillation to recover the hydrocarbon solvent and to obtain a hydrocarbon residue containing polymerized hydrocarbons, sulphonated hydrocarbons and oxidized hydrocarbons, which residue is characterized by an adhesive quality and is plastic in its nature at ordinary temperatures.

Detinning Scrap Tin

The increasing use of materials marketed in so-called tin containers makes the recovery of tin from discarded tin cans a problem of prime importance in order to obviate a large daily waste. By the method commonly used tin scrap is treated with chlorides of tin and of iron, but this process has been attended with a disadvantage that the tin has not all been removed, leaving what has become commonly called tin spots upon the sheet iron.

The waste due to the tin spots is stated to be now obviated by employing a vacuum in the vessel in which the solution of the tin takes place. The use of a vacuum facilitates the escape of the gases produced and admits of a full reaction.

The process described in Patent No. 1,41[illegible] granted to [illegible] is carried out as follows:

The tin bearing material is put in a closed container to which a solution of perchloride of tin or iron is added, so that the material to be treated is entirely immersed. A vacuum is then created and increased up to about a 15 or 20 cm. mercury column. The tin is quickly dissolved while the perchlorides are converted into protochlorides of tin or iron. The tin extracted is precipitated by zinc, iron or any other suitable agent. The solution can also be treated again by the addition of chlorine for instance, so that the initial solutions of iron or tin chlorides can be reobtained.

Self-Cleaning Electrical Precipitator

The precipitation of suspended materials from various gases by the electrical precipitation method is one which is well known. The best known example is the Cottrell process, controlled by the Research Corp. of New York.

A type of self-cleaning separator is described in Patent No. 1,412,248 granted to Myron P. Laughlin, of Lowell, Mass., assignor to the Research Corp. In this separator there is provided a suitable means for periodically cleaning both the discharge and collecting electrodes without interfering with the continuous operation of the apparatus.

This would seem to be an important advancement in that it will allow the precipitators to be continuously operated, hence avoiding delay and loss due to interrupting the operation in order that the same may be cleaned, for unless such is done the efficiency will be very greatly decreased.

Synthetic Drying Oils

The use of hydrocarbons, such as the mineral oils, as drying compositions in the manufacture of paints, appears to have been successfully worked out by Henry A. Gardner, Washington, D. C., and they should serve as a very valuable as well as an economical substitute for the drying oils commonly employed, more particularly linseed oil.

These new drying oils are susceptible of a very wide variety of uses in the paint, varnish, plastic and other arts.

The production of the new drying agents is dependent upon the use of a dechlorinated oil which is obtained by first chlorinating an oil and then splitting off hydrochloric acid, leaving an unsaturated material.

These dechlorinated oils are capable of uniting with organic acids or acid organic bodies of high boiling point, and of yielding therewith products which are of relatively low acidity or even substantially neutral; and that these products likewise possess strongly marked drying properties, usually in fact drying more rapidly than the dechlorinated oils from which they are formed, and in many instances possessing superior film-forming qualities.

The organic acid bodies which are preferably used are the resins, and particularly rosin.

The neutralization or partial neutralization of the acid organic body by the dechlorinated oil may be accomplished by simple heating under either of two general conditions, to wit:

(1) The acid organic body may be mixed with or dissolved in the chlorinated oil, and the latter then subjected to dechlorination by heating, either in presence or absence of a catalyzer, and either in presence or absence of a diluent, such as mineral spirits or the like.

(2) The acid organic body may be added directly to the dechlorinated oil and heated therewith until the acid number is sufficiently reduced, indicating the accomplishment of the esterification. This may be accomplished by heating at comparatively high temperatures, say around 250° C. for 5-7 hours, or by correspondingly longer heating at lower temperatures. If desired a small proportion of litharge or of a mixture of litharge and umber, or other suitable accelerant or drying agent, may be added in connection with either esterification method in order to hasten the reaction or to improve the drying qualities of the product.

As an example of the manner in which the new drying compositions may be obtained, the following is cited: 100 parts by weight of a paraffin type hydrocarbon oil free from low-boiling components and containing 31% of chlorine received an addition of 260 parts of rosin (acid value 158). The resulting mixture had an organic acid value of approximately 108. After heating for three hours at 320° C. the resulting mass was viscous and had an acid value of [illegible]. Heating for one more hour at a temperature of 330° C. yielded a product having an acid value of only 44. The fluidity of the product tended to increase with the duration of the heating.

Charcoal to Extract Constituents of Coal Gas

A process for more complete recovery of valuable constituents from coal gas according to which benzene hydrocarbons, sulphur, ethylene and other unsaturated aliphatic hydrocarbons or derivatives are obtained, this being effected by the use of towers charged with charcoal, is described in Patent No. 1,412,954, assigned to Badische Anilin & Soda Fabrik. It is stated that the order in which the constituents are removed, is of great importance. It has proved most advantageous to separate the substances in the order mentioned, viz., first the benzene hydrocarbons, thereafter sulphur and finally ethylene hydrocarbons. In either case the gases should be freed, either completely or else to a large extent, from tarry matter and cyanogen compounds, whereupon they are conveyed, at ordinary or slightly raised temperature, through a suitable number of towers containing activated charcoal by which the constituents desired are removed either by simple absorption or adsorption, or with the simultaneous effection of chemical or catalytic reactions as the case may be.

The compounds taken up by the charcoal can be extracted or expelled therefrom at suitable intervals of time, the benzene hydrocarbons being, for example, expelled by means of steam, sulphur extracted with the aid of suitable solvents, such as ammonium sulphide solution, and the ethylene hydrocarbons again expelled with steam. Diminished pressure and heat applied to the charcoal may be resorted to in revivifying it.

Increased Availability of Cyanamid Nitrogen in Fertilizer

Since the fixation of atmospheric nitrogen in the form of calcium cyanamid various interests have directed attention to rendering the nitrogen in the calcium cyanamid as fully available as a plant food as possible. It has been attempted to produce a fertilizer by mixing a phosphate containing free acid, with the calcium cyanamid in order to obtain a product containing urea and phosphoric acid in available form. The phosphate may be added either in the form of phosphate rock or otherwise.

Objections to this mode of procedure are that the calcium cyanamid is not effectively converted into urea except when the ratio of calcium cyanamid to the acid phosphate is very small, about 1 to 10, and that the effective conversion takes place only at a temperature of about 70-80° C. under which conditions a considerable amount of phosphoric acid is lost by transformation into soluble phosphate. These disadvantages have limited the amount of calcium cyanamid to about 6 per cent. of the amount of acid phosphate, an amount which is less than that which should be present in order to obtain the most satisfactory results.

The surmounting of the disadvantages mentioned appears to have been accomplished by Graham Edgar, Washington, D. C., as described in Patent No. 1,413,013, said patent being assigned to the United States of America, as represented by the Secretary of War. The process may be described briefly as follows:

Calcium cyanamid (20-22% fixed nitrogen) is gradually added to a strong mineral acid, preferably sulphuric acid of 20-50% strength, care being taken to prevent the temperature from rising substantially above the point at which urea readily decomposes. The gradual addition of a strong mineral acid to the cyanamid has been found to be unsatisfactory for the reason that there would not be an excess of acid present throughout the initial stage of the process and therefore the urea and other nitrogenous compounds, which are far more stable in the presence of an excess of mineral acid, would be decomposed with the consequent loss of fixed nitrogen compounds. The amount of acid required is substantially in excess of that necessary to neutralize the entire lime content of calcium cyanamid (both free and combined), such amount being determined by the conditions most favorable for the formation of urea and being preferably not less than 20% in excess of the theoretical.

Sufficient neutralizing material containing ingredients of fertilizing value, as for example commercial ground phosphate rock (preferably 100-200 mesh) is then added to neutralize the free mineral acid and, in those cases where phosphate rock is used as the neutralizing agent, to form also available phosphate, the temperature during this stage being also maintained below the point at which urea decomposes.

The foregoing procedure produces a fertilizer containing more than 50% of the total nitrogen in the form of urea, and one in which the ratio of urea to phosphoric acid anhydride will not be less than one part of urea to 3 parts of the anhydride and may be equal to or exceed the amount of the anhydride. In addition to the increased effectiveness, the objectionable action of the cyanamid upon the skin is obviated; as well as the dusting thereof, the toxic effects of the cyanamid are eliminated. Other fertilizing ingredients easily may be admixed in any desired proportion with the fixed nitrogen compound.

Increasing Efficiency of Bleaching Powder

The slowness of the bleaching action on wood pulp of calcium hypochlorite or bleaching powder has been hastened and promoted by the improvement which is described in Patent No. 1,413,154 granted to John C. Baker, of Ridgefield Park, N. J., and comprises the usual employment of calcium hypochlorite, but in addition thereto the use of an excess of free chlorine which is introduced preferably as chlorine water.

It is found by using this excess of chlorine that the mixture possesses remarkable bleaching properties, the bleaching operation is more rapid, that the final colors obtained are much whiter and that less bleach is required to produce a given effect.

In carrying out the operation the hypochlorite solution in 1½-4% concentration is added to the pulp to be bleached and either simultaneously or after its introduction into the vat the desired amount of chlorine water is added to the pulp. At any practicable temperature this method of bleaching is preferable to that involving the use of neutral or alkaline hypochlorite solutions, but even better results are secured at the somewhat higher temperatures of 100° and 110° F.

Sawdust to Separate Hydrocarbons from Propylene Alcohol

In the preparation of higher alcohols from the olefines contained in oil distillation products, either liquid or gaseous, by first forming the addition products of such olefines with sulphuric acid, and subsequently hydrolyzing the sulphated compound thus formed, the preliminary separation of the alcohols is in general effected by steam distillation of the hydrolyzed compounds or by their distillation in the presence of water. The distillate thus produced generally forms two layers: an oily layer consisting chiefly of alcohols with a small amount of water and an aqueous layer consisting of an aqueous solution of alcohols. The aqueous layer, on separation, is usually found to entrain relatively small quantities of hydrocarbons, the removal of which is highly desirable.

Matthew D. Mann, of the Standard Oil Co. of New Jersey, passes this aqueous layer through one or more sawdust beds, each of which may have a depth of about 12-24 inches. The alcoholic liquid is thereby freed from the hydrocarbons, which are selectively absorbed by the sawdust. It is the use of a selectively absorbing material such as sawdust which Mr. Mann regards as a feature of his patent, No. 1,413,864.

Completeness of removal of the hydrocarbons is determined by adding a portion of the filtrate to clear water. Turbidity indicates incomplete removal. The sawdust may be used also in agitation with the alcoholic liquor and the mixture filter pressed.

Washing Synthetic Resins

When a naphtha containing coumarone or indene is treated with sulfuric acid the coumarone and indene are polymerized. When the naphtha containing the polymerized coumarone and indene in solution is separated from the polymerizing acid, neutralized with a solution of an alkali, separated from the alkaline solution, washed, and distilled to remove unpolymerized material, the polymerized coumarone and indene remain behind in the still as a liquid which solidifies to a resin on cooling. This resin is commonly known as paracoumarone or paraindene.

The naphtha after the polymerization with sulfuric acid retains in suspension a small amount of sulfuric acid and of sulfonic acids formed by the reaction of some of the polymerizing acid upon certain of the constituents of the naphtha. Before this polymerized naphtha can be satisfactorily distilled to recover the resins these last traces of acid must be neutralized by agitating the naphtha with caustic soda solution. If this neutralization step is omitted the small amounts of acid retained by the naphtha will cause the resin obtained by the distillation of the naphtha to be very dark in color and to be less valuable for many purposes.

After the neutralization of the naphtha the major portion of the alkaline solution (containing small amounts of alkali sulfates and sulfonates) separates readily from the naphtha, and may be drawn off. A small amount of the alkaline solution and salts, however, remains suspended in the oil and cannot be separated by allowing the oil to stand for any economically practicable length of time.

The commonly used method of removing the small amounts of alkali and alkali salts retained in the oil by the formation of this suspension is to agitate the neutralized oil with successive portions of water, settling and removing each successive portion of wash water, until the ash content of the oil is sufficiently reduced. If this washing with water is omitted, the resin obtained after distilling off the volatile constituents of the naphtha will contain appreciable amounts of non-combustible impurities, as, for example, sodium sulfate and sodium hydrate. The presence of these non-combustible impurities may cause the resin to be cloudy, to absorb water, and to turn white when exposed to water, and therefore renders it less valuable. It is therefore very desirable that these impurities be removed as completely as possible.

Frederick H. Rhodes and Alfred E. Roberts, Philadelphia, Pa., in Patent No. 1,413,558 specify the use of chlorides of the alkali or alkaline earth metals in varying density of aqueous solution, 3% NaCl being found satisfactory, to facilitate the washing of the naphtha and the reduction of the tendency to form emulsions.

Extracting Cyanogen from Coke-Oven Gases

The commercial process for the removal of cyanogen from coal gas is that used by the British Cyanides Co., which consists in washing the gas with ammoniacal liquor in combination with sulphur. As a result the ammonium sulphide present in the liquor dissolves the sulphur to form a polysulphide which reacts with the hydrocyanic acid in the gas and forms ammonium sulphocyanide (NH_4CNS). The object of Max E. Mueller's patent No. 1,413,762 is to provide a method for extracting cyanides from gases, in the form of an alkaline cupro-cyanide, and to recover it as such or to convert it into other desirable compounds.

Mueller has found that if coke-oven gas which contains hydrocyanic acid and hydrogen sulphide, is treated with sodium carbonate solution carrying in suspension copper carbonate, the copper will gradually pass into solution with the absorption of the hydrocyanic acid from the gas. Expressed as chemical equations the reactions probably are as follows:

1. $CuCO_3 + H_2S = CuS + H_2O + CO_2$; and
2. $2CuS + 2Na_2CO_3 + 8HCN = 2Na_2Cu(CN)_3 + 2H_2S + 2CO_2 + (CN)_2 + 2H_2O$.

According to the above, when using a cupric compound such as copper carbonate, a portion of the cyanogen is lost. However, by the use of a cuprous compound, such as cuprous oxide, Cu_2O, no cyanogen is lost, the cuprous sulphide formed in this case reacting as follows:

3. $Cu_2S + 2Na_2CO_3 + 6HCN = 2Na_2Cu(CN)_3 + H_2S + 2CO_2 + 2H_2O$.

The loss of cyanogen can also be avoided by using a cupric compound in the presence of metallic copper, the reaction then being:

4. $CuS + Cu + 2Na_2CO_3 + 6HCN = 2Na_2Cu(CN)_3 + H_2S + 2CO_2 + 2H_2O$.

Furthermore metallic copper without any other copper compound may be used, since the gases in question, containing hydrocyanic acid and hydrogen sulphide, generally also contain a small percentage of oxygen, which under the conditions will oxidize the metallic copper and the reaction will take place as with a cuprous compound present.

In the above reactions sodium carbonate is used as the alkali to illustrate the nature of the reaction, but any carbonate or hydrate of any alkali or alkaline earth metal, may be substituted for sodium carbonate, or, if the gas contains ammonia, the ammonia may serve as the alkali.

The solution of di-sodium copper cyanide, $Na_2Cu(CN)_3$, or other alkaline copper cyanide obtained by the foregoing process generally contains an excess of alkaline carbonate with some free hydrogen sulphide and carbon dioxide. From this solution a number of commercial products may be prepared.

Removing Sulphur from Petroleum

A process for removing sulphur from petroleum particularly [illegible] Patent 1,41[illegible] Standard Oil Company [illegible] forming higher sulphides. Therefore, there is added an hydroxide which will combine with the hydrogen sulphide forming a simple sulphide which in turn will combine with the free sulphur forming higher sulphides and thereby removing them.

The complete removal of the free sulphur therefore, is dependent on the amount of hydrogen sulphide present. This amount must be sufficient to yield a quantity of simple sulphide, which in turn will be sufficient to combine with all of the free sulphur.

The process, therefore, is divided into two classes, viz., one in which the amount of the hydrogen sulphide is sufficient to accomplish the completion of the reaction, and the other in which it is not sufficient. In the first case an amount of the hydroxide is added sufficient to combine with the hydrogen sulphide and in order to determine the exact amount, it is necessary to experiment upon the oil being treated. In the latter case the hydroxide is added in an amount to react with the hydrogen sulphide and an additional sulphide, either of the alkali or of the alkaline earth metals is added until the sulphur is completely removed. The process is carried out at atmospheric pressure and at a temperature varying from 160° to 190° F.

Condensation Products from Phenol

It is well known that phenol or its homologues and formaldehyde or its polymers are capable of reacting to yield a condensation product of a resinous character, the properties of which depend upon the duration of the heating, the nature of the condensation agent, the quantities of the different chemicals employed and other conditions. As condensation agents both acids and bases are used, as well as salts, natural resins, soaps, etc. When using acids as condensation agents, fusible resins are produced as a rule, which may be heated to any temperature without being converted into insoluble and infusible products, whereas the application of bases or materials acting as a base yields resins which on further heating are quickly transformed into insoluble and infusible products.

Kulas and Pauling of Leipzig, Germany (Pat. No. 1,414,139), have found that by carrying out the process in two phases or stages, results are attained that could not be foreseen. In the first stage, they effect the condensation by means of an acid and after the resin has been formed they apply in the second stage a base as condensation agent in a quantity, that far surpasses the amount needed for neutralizing the acid used in the first stage and must even considerably exceed 10% of the quantity of the active phenolic body. They found that the consumption of formaldehyde is essentially less than in all the processes hitherto known, whereas the yield of the resinous body is considerably higher.

One hundred parts of phenol and cresol and 50 parts 40% formaldehyde yield 80 parts of the artificial resin. The losses always occurring when using acids as condensation agents are reduced to a minimum by the alkaline condensation in the second phase. The resins produced in the acid medium act moderatingly on the reaction, the frothing of the mass is much less and the formation of the resin is greatly accelerated, so that there is a great saving in the raw material, fuel, time, power, wages, etc. By decreasing or increasing the total quantity of formaldehyde fusible or infusible resins are produced at will and the nature of the resin can, therefore, be suited to its application.

The solubility of the resins thus made is notable. They dissolve not only in the usual solvents for artificial resins, but also in both cold and warm alcohol without residue, in mixtures of benzol and solvent naphtha, benzol and acetone, technical benzol and denatured 95% alcohol. If in the preparation of fusible resins an addition of 2 to 3% of a hydrosulphite or a sulphite be made and at the same time about 12% of soap, the resin produced is completely soluble in benzol, artificial turpentine or in a mixture of benzene and fat oils. The properties of dissolving accompanied by quick drying and hardening of the varnishes thus prepared make these resins an excellent substitute for copal and dammar resins and shellac. Hitherto it has been found necessary to add some natural resins, like rosin, copal, dammar, fatty oils, etc., to the artificial resins, when required to dissolve the latter in benzol, oil of turpentine and the like. Such an addition is no longer necessary and can be dispensed with. As a matter of course, not only phenols, like cresol or carbolic acid can be used in the preparation of the artificial resins, but the common formaldehyde can be replaced by trioxymethylene or hexamethylenetetramin.

Robert W. Hilton, chemical engineer, formerly vice-president, Ault & Wiborg Co. and A. B. Davis, assistant general manager, Cincinnati Chemical Works, have organized a corporation, of which the former is president and the latter secretary-treasurer, to operate technical and research laboratories at Cincinnati, Ohio, and to engage in general consulting chemical practice.

Personal Items

William C. McIntire, formerly of the Cincinnati Chemical Works, is now at the Chicago plant of the Sherwin-Williams Co.

* * *

R. W. Brokaw, plant manager, Arlington, N. J., plant, E. I. du Pont de Nemours & Co., has been appointed director of manufacture.

* * *

Carl E. Hartwig, formerly of Chemical Warfare Service, Edgewood Arsenal, is now research chemist, Garfield Worsted Mills, Garfield, N. J.

* * *

Dr. Gebhardt Bumcke, formerly of the National Oil Products Co., Harrison, N. J., is now technical director, Trades Oil Products, Inc., Newark, N. J.

* * *

J. H. Mason, formerly of the Duratex Co., Newark, N. J., is now general manager, Vulcan Proofing Co., a subsidiary of the C. Kenyon Co., Brooklyn, N. Y.

* * *

H. E. Haines, formerly of the Laboratory Department, Armour & Co., at 120 Broadway, New York, has resigned to go into business for himself at Reading, Pa.

* * *

Dr. R. B. Moore, chief chemist, Bureau of Mines, sailed on May 6 to spend two months in Europe on the work of the Bureau in chemical and mineral technology.

* * *

Dr. Major E. Holmes, manager chemical department, National Lime Association, Washington, D. C., was married on April 27th to Miss Juanita Garr at La Grange, Ky.

* * *

R. E. Zimmerman, director, research laboratory, American Sheet & Tin Plate Co., has been appointed assistant to S. A. Davis, vice-president in charge of operations.

* * *

F. M. Harrison has resigned as president of the U. S. Industrial Alcohol Company and is succeeded by H. S. Rubens, chairman of the board, who will continue also in that position.

* * *

H. G. Tanner, chief chemist of the former kelp-potash plant of the Bureau of Soils at Summerland, Calif., is now assistant professor of chemistry, University of Oregon, Eugene, Ore.

* * *

G. M. Moffet, of the Corn Products Refining Co., has sailed for Germany, where he will look after the company's manufacturing interests there, which embrace three separate plants.

* * *

Arthur H. Nellin, formerly assistant superintendent, Premier Rubber Co., Kansas City, Mo., has returned to his former duties in the laboratory of the Republic Rubber Corp., Youngstown, Ohio.

* * *

Milton Kutz, for the past 12 years Philadelphia sales manager, Roessler & Hasslacher Chemical Co., has been transferred to the same position at the New York office, 709 Sixth avenue, New York City.

* * *

H. D. Peffer, general sales manager, Chicago, western division, U. S. Industrial Alcohol Co., has been transferred to the New York office, 27 William St., to serve as vice-president and director of sales.

H. J. Jackson, manager, purchasing department, National Varnish Co., Long Island City, N. Y., will engage in independent business in vegetable oils and varnish gums at 59 Pearl St., New York City.

* * *

Harvey J. Skinner, of Skinner, Sherman & Esselen, Inc., Boston, Mass., is absent on a month's trip to Cuba to inspect the sugar properties of the United Fruit Co., for which his organization is consulting chemist.

* * *

R. D. Oilar, chemical engineer, St. Louis, Mo., is en route to Canete, Peru, to install an edible and industrial oil products plant at that place. Before his return he will make a business trip to Chili, Argentina and Brazil.

* * *

D. A. Pritchard, electro-chemical superintendent of the United Alkali Co., in England, has been appointed works' manager, Canadian Salt Co., Windsor, Can. A 10-ton daily capacity liquid chlorine plant will be installed.

* * *

Herbert Talley, chief engineer of the Hercules Powder Company, Wilmington, Del., has resigned to become an executive of the United States Powder Company, Terre Haute, Ind., in which company he is financially interested.

* * *

Abraham A. Orlinger, holder of the New York Chemists' Club's Hoffman scholarship in 1919-20-21 and of the Bloede scholarship in 1921-22, will complete in June the course of the M. I. T. School of Chemical Engineering Practice.

* * *

Joseph Plaut, of Lehn & Fink, wholesale druggists, New York City, on his return from a European trip which covered Germany, emphasized the industrial activity of the German people. He said they can pay, and should be made to pay, the reparations.

* * *

Charles L. Norton, head, division of cooperation and research, Massachusetts Institute of Technology, has been appointed head of the department of physics, made vacant by the acceptance by Professor E. B. Wilson of a call to the Harvard School of Public Health.

* * *

R. T. Stull has been transferred from the superintendency of Ceramic Station, Bureau of Mines, at Columbus, O., to the position of supervising ceramist of the bureau, under the chief mineral technologist, with headquarters at Columbus. He is succeeded by George A. Bole.

* * *

W. H. Campbell, formerly general sales manager of the Charleston Industrial Corporation, Nitro, W. Va., announces the opening of offices at 30 Church street, New York, under the name of W. H. Campbell, Inc., for the sale of new and used chemical refrigeration and power apparatus.

I believe that a society devoted exclusively to the economic aspects of the practice of chemistry would have very great possibilities of service both to the manufacturer and to the chemist.—*Dr. Robert Herman Bogue, Industrial Fellow, Mellon Institute of Industrial Research, Pittsburgh, Pa.*

Industrial Notes

Copra Silk Co. will build artificial silk plant, to cost $2,000,000, in Paterson, N. J.

* * *

Kansas City Testing Laboratories, Kansas City, Mo., will erect a three-story brick laboratory structure, costing $16,000.

* * *

Wheeling Oxygen Co., capital $200,000, has been incorporated by P. J. McGinley, W. H. Frank and James W. Ewing, of Wheeling, W. Va.

* * *

The Corn Products Refining Co. has segregated its three plants in Germany in a separate German corporation, with a capitalization equivalent to $1,000,000.

* * *

Ebony Carbon Co., Breckenridge, Texas., plans the erection of a carbon black plant of 3,000 lbs. daily capacity, which will require about 2,000,000 cu. ft. of natural gas.

* * *

The Retsof Mining Company, Retsof, N. Y., is having plans prepared for a new one and two-story salt mining and refining plant, to cost in excess of $300,000, including machinery.

* * *

The Nashville Pulp & Paper Co., Jacksonville, Tenn., has preliminary plans prepared for additional units to its plant at the former Old Hickory munitions plant, to cost in excess of $50,000.

* * *

The Gypsolite Company, capital $1,000,000, J. F. H. Haggerty, 66 Bedford avenue, Buffalo, president, will construct a new plant for the production of gypsum at Batavia, N. Y., to cost $90,000.

* * *

Maas & Waldstein Company, manufacturers of lacquers and lacquer enamels, announce the removal of their executive and sales offices from 92 William St. to larger quarters at 45 John St., New York.

* * *

The Nichols Copper Co. has acquired the selling agency of the copper output of the Granby Consolidated Mining Co., which is now smelting at the rate of 3,000,000 pounds a month. Heretofore its copper was marketed by the American Metal Co.

* * *

The Research Corporation, 31 West Forty-third street, New York, is considering a site at Dover, N. J., for the erection of new machine shops and structural iron working plant. Other locations in New Jersey also are said to be under consideration.

* * *

The DuPont Fibre Silk Company, Buffalo, N. Y., will add a new unit to its plant, estimated to cost $2,000,000 and to be completed by the end of the year. Present floor space of 225,000 sq. ft. will be increased 200,000 sq. ft., and the present output, 1,500,000 lbs., will be doubled.

* * *

The Electroplax Co., Ltd., Toronto, Can., has been organized to manufacture in Canada the products of the Redmanol Chemical Products Co., Chicago, Ill., and the Cutler-Hammer Co., Milwaukee, Wis., H. E. Corey is president and general manager and Dr. L. V. Redman vice-president.

* * *

A reflection of improving business conditions is found in the report of the Mathieson Alkali Co., Inc., which shows net profits of [illegible] for the first quarter of 1922 as against a loss of [illegible] for the same period of 1921; on the basis of about 100 per cent increase in the volume of sales.

* * *

Tidewater Chemical Company, Inc., 440 Washington St., New York, will continue as successors the business of Katzenbach & Bullock Trading Company, Inc., having purchased the assets and good will of that company. E. L. Bullock, formerly vice-president of the latter company, holds the same office in the Tidewater Chemical Company.

* * *

The Clairton, Pa., by-product coke plant of the Carnegie Steel Co., already the largest installation of by-product coke ovens (768 koppers) in the world, will be enlarged by the addition of 14 batteries of 896 ovens. The additional coking capacity will provide for an annual output of 11,000,000 tons, which is more than half as much as the U. S. Steel Corporation has ever produced in a year.

* * *

Hooker Electrochemical Co., 25 Pine St., New York, has bought from the referee in bankruptcy the plant and business of S. Wander Sons & Co., Albany, N. Y., manufacturers of potash and lye. The consideration was $130,000 which embraced claims arising from damage action aggregating $800,000, brought by customers of the bankrupt who had been injured by explosions of cans of bleaching powder.

* * *

The Titanium Pigment Co., 94 Fulton Street, New York, with plant at Niagara Falls, N. Y., has acquired the plant and business of Buckman & Pritchard, Inc., of the same address, manufacturer of zirconium silicate, etc., with works at Mineral City, Fla. The purchase includes the holdings of H. H. Buckman and G. A. Pritchard. The new owner will continue the plant as heretofore, and plans for extensive operations and expansion.

* * *

Following upon the conclusion of the hearings of the sub-committee of the Senate Committee of the Judiciary in its investigation of an alleged monopoly in domestic dyestuffs manufacture, the American Dyes Institute passes out of existence, its functions being continued on a broader scale by the Synthetic Organic Chemical Mfgrs. Association, 1 Madison Ave., New York, which in its promotion of synthetic organic chemical manufacture, has dyes and intermediates as only one of its sections.

* * *

The Redmanol Chemical Products Co., Chicago, Ill., has made a settlement of the recent action by the General Bakelite Co. against the General Insulate Co. for infringement in the use of redmanol by the last named company. This action though brought against its customer was defended by the Redmanol Co. The decision sustained the Baekeland patents as covering broadly, on the one hand, the combination of phenol condensation products with fibre and fibrous materials, and on the other hand the simultaneous use of heat and pressure in the manufacture of articles made from these products. The Redmanol Co. has now consented to a decree and paid heavy damages in liquidation. Redmanol hereafter will be made under license. The validity of the Baekeland patents is thus confirmed; previously the validity had been acknowledged by the Condensite Co. of America, a licensee of the General Bakelite Co. The products of these three companies are well known under their respective trade names of Bakelite, Redmanol and Condensite.

CHEMICAL AGE

A CONSOLIDATION of THE CHEMICAL ENGINEER and CHEMICAL AGE

LLOYD LAMBORN, *Editor*

VOLUME 30 NEW YORK, JUNE, 1922 NUMBER 6

The Place of Scientific Research in the Programs of Trade Associations

By Edward R. Weidlein

Director, Mellon Institute of Industrial Research of the University of Pittsburgh

EDWARD R. WEIDLEIN

Director, Mellon Institute of Industrial Research of the University of Pittsburgh.

RECENTLY I had the pleasure of reading two interesting contributions to our knowledge of lime, that alkaline earth which is of so great economic importance, and which, while its application for several purposes (mortar making and causticizing soda) dates from a very early period, is, for the first time in its history, now receiving elaborate systematic study. The first article was by M. E. Holmes and presented an informative outline of the numerous uses of lime; it is, indeed, one of the most comprehensive studies of the applications of a key product that has come to my attention, and is, moreover, of suggestive value to research workers in all the basic industries. The other paper, by G. J. Fink, of the Research Laboratory of the National Lime Association, was entitled "Investigation of Whitewashes and Aqueous Lime Paints." A modern study of ancient, but most widely used, paints, it is certain to arouse a new interest in an important outlet for lime.

Fink's research report impressed me as being noteworthy in two respects: In the first place, it is, as hinted, replete with findings of economic value to lime manufacturers; and, secondly, it will be of similar value to those industrialists who make the various addition agents which were tried with beneficial results to the films. It is, in fact, a unitary demonstration of the ramifying and far-reaching possibilities of scientific inquiry. And there are many such examples.*

The chemical profession is following with appreciation the research campaign of the National Lime Association. It attaches like importance to the activities of the Interdepartmental Conference on Chemical Lime, which is preparing specifications for the different kinds of lime used as chemical reagents in various industries. Work of this character is only successful when conducted by an amalgamation of related industrial interests; and by encouraging standard manufacturing practice and by insuring uniformity of products, it provides ample justification for the existence of trade or industrial associations which are organized for "technologic advancement through research," the slogan of all progressive industrial firms of today.

In fact, it is now realized by leading manufacturers that the methods of science are the most effective procedures thus far developed for the advancement of physical and chemical technology, and that accordingly scientific investigation is an essential economic adjunct to industrial enterprises. This understanding of the significance of scientific research, of the importance of utilizing available and advancing scientific knowledge, has enphasized to a degree not hitherto attained in the history of American industry the perils of ignorance and destructive competition. It has shown clearly the necessity for sympathetic coöperation in the exchange of information. The encouragement of research and the recognition of the desirability of disseminating the knowledge gained are among the outstanding signs of the times. Even a casual inspection of the development of industrial economics demonstrates that the evolution from an era of secrecy has been remarkably rapid.

Reduced Production Costs and the Birth of New Industries a Function of Research

If the efforts now being made to establish comprehensive plans for the resuscitation of industry within our nation are to succeed, financial support on a very liberal scale must be forthcoming from industry itself for the advancement of scientific research. In order to prevent disappointment, and a possible reaction in the future, in those who endow scientific research, it is necessary to give a word of warning. It must be remembered that the history of science abounds in illustrations of discoveries regarded at the time as trivial which in after years became epoch-making.

---

*An address delivered at the Fourth Annual Convention of the National Lime Association, Cleveland, Ohio, June [illegible]

In illustration may be cited Faraday's discovery of electromagnetic induction. He found that when a bar magnet was thrust into the core of a bobbin of insulated copper wire whose terminals were connected with a galvanometer, a momentary current was produced; while, on withdraing the magnet, a momentary reverse current occurred—a purely scientific experiment destined in later years to develop into the dynamo, and with it the whole electrical industry. Another illustration may be given: Guyton de Morveau, Northmore, Davy, Faraday and Cagniard Latour between 1800 and 1850 were engaged in liquefying many of the gases. Hydrogen, oxygen, nitrogen, methane, carbon monoxide and nitric oxide, however, resisted all efforts, until the work of Joule and Andrews gave the clue to the causes of failure. Some thirty years later, by careful application of the theoretical considerations, all the gases were liquefied. The liquefaction of oxygen and nitrogen now forms the basis of a very large and important industry. Such cases can be multiplied indefinitely in all branches of science.

Perhaps the most pressing need of the present day lies in the cultivation of a better understanding between our great masters of productive industry, the stockholders to whom they are in the first degree responsible, and our scientific workers. If, by reason of any turbidity of vision, our large manufacturing corporations fail to discern that, in their own interest, the financial support of scientific research should be one of their first cares, technical advance will slacken, and other countries, adopting a more far-sighted policy, will forge ahead in science and technology. It should be the bounden duty of everyone who has at heart the aims and objects of patriotic Americanism to preach the doctrine that in closer sympathy between all classes of productive labor, manual and intellectual, lies our greatest hope for the future.

A distinguished educator, Nicholas Murray Butler, said a while ago: "Probably no one will dispute the statement that the central science just now—the one that is likely to remain the central science for some time to come—is that many-sided body of knowledge called chemistry." Chemistry may indeed be looked upon as a gem, beautifully cut by painstaking and keenly accurate research, with its many facets. The light from its composite face can illumine the whole technology but enlightens only those branches of manufacture which are open for its reception. There is an old saying that where there is no sunlight there is disease. Alert, aggressive manufacturers concede that scientific research is essential for the well-being of industry, and that where there is no research there is insecurity with respect to the future. Chemistry is difficult to define precisely and as satisfactory a definition as any—that is, for the present occasion—is "the intelligence service of technology."

Chemistry took its origin out of knowledge of small mysteries. Even today many reasonably may look with wonder at the accomplishments of the research chemist who seems to be a master at massive as well as at diminutive legerdemain. But closer scrutiny reveals the material value of chemical wonder-working for industry, difficult as it is to estimate even roughly the financial gains which have been derived by manufacturers as a result of research activities in their behalf. Then, too, benefits of this nature cannot be measured wholly in monetary return, for everyone is familiar with the humanitarian benefits.

The Economy of Research

That center of dendrochemical investigation, the Forest Products Laboratory, at Madison, Wis., is saving $30,000,000 annually to American industries by the work which it has carried out. The perfection of the x-ray tube is the nucleus of an annual business, including accessories and generating apparatus used in x-ray work, of from 5 to 10 million dollars a year. A prominent baking company initiated a research which led to the discovery of a product which saves American, Canadian and British bakers not less than $40,000 per day, without detriment to the quality of the bread. And so the record goes on. Great economies are constantly being effected in manufacturing, new products are being discovered, and novel uses are being found for old products. The modern history of technology shows that properly planned, systematically conducted scientific research is an investment.

Some one has estimated that one-half billion dollars is being saved annually through research for industry in the United States alone. Perhaps this calculation is the result of chemical enthusiasm, but there is no doubt that many millions of dollars are being conserved in this way. The financial value of research-results in agriculture, the backbone of the nation, is of a similar high order.

It is not surprising to learn, therefore, that about $35,000,000 is being spent annually by American manufacturers in the conduct of chemical laboratory research. No doubt a like amount is expended in experimental and development work in plants, that is, beyond the laboratory stage. These figures indicate an abidingly vital confidence, and the favorable impression is enhanced when one learns that a successful company is expending as much for research as it is for advertising. And why not? Is not the encouragement and support of research the tangible evidence of forethought? There is a philosophical proverb that "if a man take no thought about what is distant, he will find sorrow near at hand."

The Trade Association and Research

To return to association research and the coordinated, productive teamwork for technical advancement which it promotes, a prominent chemist recently addressed an inquiry to ten leading associations of manufacturers which are conducting research, requesting an expression of opinion respecting the value of scientific investigation. The officials of these associations were all warm in their commendation of its technical usefulness and commercial remunerativeness. They were unanimous in endorsing the laboratory as an essential adjunct to the plant.

In general, it may be said that the trade associations which are supporting scientific investigation in this country consist of those firms in an industry whose interests are sufficiently homogeneous to induce them to pool their resources for the purpose of research. The research laboratories maintained by these associations of manufacturers not only enable a central group of scientists to be of direct service to a number of industrial concerns instead of to an individual company, but their successful operation also gives rise to more stable relations of coöperation among the company-members of these associations by the induction of the reciprocal exchange of experience and research results. Laboratories of this type act as clearing-houses of information for the industrial associations, and give technical assistance and scientific advice to the company-members. One of the prominent advantages of industrial association research in a central laboratory maintained in common by all the company-members of the association is that, *inter alia, it* enables a small manufacturer, who cannot afford to support a laboratory of his own, to profit from the investigatory work in the same way as the larger manufacturer. Indeed, industrial association research reduces the cost factor to a minimum and thus promotes the welfare of the manufacturers in the field concerned, without respect to size.

The centralization of research effort, such as is done in the laboratories maintained by industrial associations, prevents unnecessary repetition in scientific inquiries. Theodore N. Vail once said, "By carefully avoiding a duplication of work and by utilizing all that pioneer investigators have done, the fruitfulness of research can be greatly increased."

Objects of the Industrial Research Laboratory

The objects of every properly operated industrial research laboratory are three in number, viz.: (1) the creation of technically important knowledge; (2) the dissemination of knowledge and the direct industrial application of such knowledge; and (3) systematic coöperation, through contact with the other departments of the industry, and, in the case of associations, with all divisions of the association office as well as with all company-members, either directly or through the central office. It follows that in the long run an industrial research establishment must be known by the successful commercial processes which it has developed and by the published accounts of the investigations conducted in it.

It is of prime importance to the progress of science and technology to transmit as soon as possible after their completion trustworthy records of methods, achievements, and even of errors and failures. Industrial associations almost without exception find it expedient to release the research findings of their laboratories for publication. While the individual manufacturer might find it desirable to retain entirely for his own use the results of researches supported by him, the industrial association invariably encourages research on problems of general interest and consequently it would be a near-sighted policy to hold back the results from the public. It is in association research work that the publicity value of research becomes most apparent.

Results of Industrial Research

It remains to conclude by summarizing the effects on the welfare of any industry which organized scientific research is likely to have.

There is first of all the direct effect. A full knowledge, widespread through the industry, of the principles underlying works and mill practice will enable it to look forward to the future without dread. It should be emphasized that improvements in mechanical appliances and the introduction of more scientific processes are not likely to have the effect of diminishing the number of persons engaged in a well organized industry. Every improvement in the methods of production will have one of two results: either it makes the goods more cheaply or it makes them better. If it makes them more cheaply, it enlarges the existing demand; if it makes them better, it attracts a new market. In every case, then, both labor and capital—to use the common terms—are likely to benefit. The extension of the commercial uses of industrial products, another consequence of research, is also beneficial to the public as well as to the manufacturers interested.

There are other indirect gains which may be noted in passing. The first is that an industry conducted on scientific lines attracts a better type of worker than one where no scope for the use of scientific knowledge exists. Therefore, the more use that we make of science, the more do we raise the standard of education among workmen.

There is a second indirect gain from research. Everyone who begins to have experience of industrial research at once looks at the industry from a new viewpoint. Many men have had this experience and have found that what they had regarded as a dull round of mechanical operations, pursued solely for the sake of making a living, is in fact an interesting subject of study. From the time that they have begun to realize the possibility of improvement through knowledge, their work has become their hobby; and what man, whether workman or industrialist, is more fortunate than he who is daily absorbed in an occupation in which he has a living interest?

Attendance at Engineering Colleges in the United States

The U. S. Bureau of Education, at the suggestion and with the cooperation of the Society for the Promotion of Engineering Education, has secured an accurate statement, reported in the *Bulletin* of the Society, of the enrollment of students at the engineering colleges of the country. In the following table is summarized the detailed statement of each institution, giving the attendance in freshman, sophomore, junior and senior classes and the number of special students.

Curriculum or Specialization	Freshman and Sophomore Classes[a]	Junior Classes	Senior Classes	Special	Total[b]
Civil Engineering	11,362	2,486	1,915	241	15,991
Mechanical Engineering	6,604	2,909	2,210	154	11,834
Electrical Engineering	7,368	2,853	1,868	114	12,200
Chemical Engineering	2,727	1,304	1,106	101	5,028
Architecture	678	188	118	42	1,026
Arch Engineering ...	319	100	74	21	574
Administration Engineering ..	346	215	164	0	725
Textile Engineering	210	97	83	18	408
General Engineering . ..	300	130	85	224	764
Industrial Engineering	193	110	75	11	389
Agricultural Engineering	220	111	77	0	367
Commercial Engineering	144	90	42	0	277
Ceramic Engineering	84	24	21	37	166
Naval Engineering[c]	50	27	34	1	112
Electro-Chem. Engineering ...	43	24	28	0	95
Marine Engineering	26	12	19	2	59
Aeronautic Engineering	21	10	15	2	62
Railway Engineering[d] .	20	12	16	1	49
Sanitary Engineering	10	6	18	0	34
Chemistry	213	110	88	16	427
Physics and Science ..	36	28	18	2	84
Industrial Education	6	0	0	0	6
Industrial Management	5	1	3	0	9
Engineering Economics	12	2	8	0	22
B. S. Degree[e] . ..	9	0	5	0	14
Other Specialties[f]	0	21	2	0	23
Mining and Metallurgy	1,172	576	428	140	2,669
	32,178	11,446	8,520	1,127	53,414

[a] Freshman and Sophomore classes are considered together because of duplication.
[b] Totals are not valid for comparative purposes.
[c] Includes Naval Architecture.
[d] Includes Civil, Electrical, and Mechanical, Railway Engineering.
[e] No specialized degrees offered.
[f] Automotive, Electromechanical, Geological.

The Southern Gas Association, in cooperation with Johns Hopkins University, plans to establish a chair in gas engineering at that institution, $1,000 a year for five years already having been pledged. The Association will undertake to raise $5,000-6,000 a year for a period of five years, during which time it is expected that results will be such as to guarantee its permanency.

Nitric Acid from Saltpeter or Synthetic Ammonia

Cost Factors and Conditions That Will Determine the Raw Material of Nitric Acid Manufacture

By Guy B. Taylor

Experimental Station, E. I. du Pont de Nemours & Co.

IF the primary product obtained by oxidizing ammonia were strong nitric acid, then ammonia on a price parity basis with Chilean saltpeter would be incomparably cheaper than saltpeter as a source for nitric acid. Unfortunately the primary product of ammonia oxidation is nitric oxide; the cost of converting this oxide of nitrogen into strong nitric acid is considerable, in spite of the fact that the raw materials, water and air, cost practically nothing. The industrial uses for weak nitric acid are so limited in extent that the oxidation of ammonia for the production of weak acid is of minor interest in the discussion.*

Economy of Ammonia Oxidation

The question, then, of when it is economical to oxidize ammonia and when not to oxidize ammonia centers largely around the question of the cost of concentrating nitric acid. This state of affairs will continue as long as a small price differential exists between Chilean saltpeter nitrogen and ammonia nitrogen. With the development of synthetic-ammonia processes, the price differential is likely to change in favor of ammonia and the relative importance of nitric-acid concentration will vary as a factor in the situation.

The next most important factor, after raw materials concentration costs, is the scale of manufacture. Nitric acid is an extremely corrosive liquid, making its transport difficult and expensive. Hence nearly all large users manufacture at the place of consumption. Ammonia oxidation plants are not inexpensive to build and the first cost per ton of rated capacity is naturally greater the smaller the output. It might pay to construct a new plant to produce nitric acid by oxidizing ammonia, while under a similar set of circumstances it would not pay to scrap a going retort process.

Comparison of Equipment and Procedure

Before proceeding to more detailed comparisons, it is advisable to outline briefly the character of the plants required for the two processes. The essential units in the respective equipments are:

AMMONIA OXIDATION	SALTPETER PROCESS
1. Ammonia liquor storage.	1. Soda storage.
2. Ammonia gas plant.	2. Sulphuric acid storage.
3. Ammonia converters.	3. Retorts.
4. Absorption system.	4. Condensers and receivers.
5. Nitric acid concentration	5. Absorption system.

Ammonia Oxidation.—In the ammonia-oxidation plant ammonia gas is distilled from the liquor and mixed with air. The gas mixture is then put through a catalyst in the converter whereby nitric oxide and water vapor are produced. The gas then passes to the absorption system, where, coming in contact with water and air, the nitrogen oxides are converted to weak nitric acid with a strength of about 50 per cent. This weak acid is concentrated to 90+ per cent HNO_3 by distillation from sulphuric acid. This results in the production of weak sulphuric acid, from which the water must be boiled out in order that it may be used again.

Saltpeter Process.—In the saltpeter process sodium nitrate and sulphuric acid are charged into cast iron retorts and heating [illegible] and is distilled out and condensed. Toward the end of the distillation the distillate weakens somewhat due to thermal decomposition of HNO_3 and the release of water from the charge, previously held by the sulphuric acid. This weaker distillate is in some cases caught in a separate receiver and in others mixed with the strong distillate. Some nitrogen peroxide is evolved and recovered as dilute acid in the absorption system. The dilute absorption-system acid and the weak distillate together seldom amount to more than 10 per cent of the yield.

In the ammonia-oxidation process all of the output is recovered first as dilute acid, which must be concentrated, while in the saltpeter or retort process upward of 90 per cent of the output is directly recovered as strong acid. On the other hand, the retort process consumes sulphuric acid in about equal tonnage with Chilean saltpeter and the ammonia-oxidation process consumes none, except the small quantity lost in repeated reconcentration of sulphuric acid required for dehydrating weak nitric acid.

As a basis of comparing the two processes let us take a case favorable to ammonia oxidation. Let us assume that a new plant for nitric-acid manufacture is to be built in a locality favorable to large-scale production, say a place where 25,000 tons of HNO_3 per year can be disposed of. This is a convenient capacity rating to assume, because it approaches the largest conceivable peace-time production in any one place and because a plant of this size was actually built in this country during the war (U. S. Nitrate Plant No. 1).

This gives us a line on probable plant cost. Such a plant will cost, say, $1,000,000, or $40 per ton-year. The first cost of a retort plant on this scale will amount to, let us say, $12 per ton-year, or less than one-third as much. The cost of operating the two plants will vary from time to time, but our estimate is that this cost will average about the same for each—that is, $10 per ton of product figured as 100 per cent HNO_3. This item, hereafter designated "operating cost," includes operating labor, repair labor, repair material and replacement, fuel and power, and superintendence. In the case of the ammonia-oxidation process the operating cost of the concentration unit is excluded. The retort process requires about 1.4 tons of sulphuric acid per ton HNO_3. If this acid costs $16 per ton, the sulphuric acid cost per ton of HNO_3 will be about $20, making due allowance for niter cake credit.

In order to eliminate what may be termed the minor variables in the problem, let us assume the cost factors arrived at above are constants and study the major variables—nitrogen costs, yields and concentration costs. The assumed constants may then be summed up as follows and the sum designated "conversion cost":

	Ammonia Oxidation (As 50% Acid)	Chilean Saltpeter (As 90+% Acid)
Operating cost	$10	$10
Fixed charges at 15%*	6	2
Sulphuric acid	0	20
Conversion cost per ton of HNO_3	$16	$32

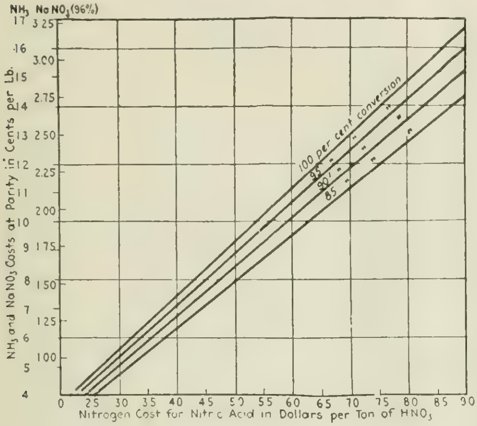
---

* A paper presented at the [illegible] meeting of the American Institute of Chemical Engineers, [illegible]

* Includes the items of taxes, insurance, interest, amortization and obsolescence.

Nitrogen Costs

In the accompanying chart, the relations between the nitrogen costs of the raw materials and the finished product for various conversion efficiencies are presented graphically. The ordinate shows the costs of ammonia and sodium nitrate at parity in cents per pound and the abscissa the corresponding nitrogen cost for nitric acid in dollars per ton of HNO_3 at various conversion efficiencies. The nitrate is figured as 96 per cent pure.



The yield from nitrate may be conservatively put at 98 per cent and that from ammonia at 90 per cent (95 per cent oxidation efficiency and 95 per cent absorption efficiency). At these yields, with ammonia and nitrate at parity, and varying in price from 8c. to 15c. for NH_3 and 1.5c. to 2.9c. for nitrate, the total cost for nitric acid from ammonia varies from $64 to $106 per ton and for nitrate from $76 to $115 per ton. The spread between the two processes is only $12 at the lower nitrogen cost and $9 at the higher. That is to say, if 50 per cent nitric acid can be concentrated for much less than $10 per ton, it pays to oxidize ammonia when ammonia and nitrate costs are on a parity basis.

The following tabulation gives a few examples of the spread between the two processes when nitrogen costs are not on a parity basis:

Cost of NH_3 Per. Lb.	Cost of $NaNO_3$ Per Lb.	Ammonia Oxidation Cost of HNO_3 Per Ton (50%)	Chilean Saltpeter Cost of HNO_3 Per Ton (90+%)
8c.	1.75c.	$64	$82
10	2.25	76	97
12	2.50	88	103
12.5	2.25	91	97

The first three cases in the above tabulation are taken at prices showing not unusual disparities in price quotations between ammonia and nitrate, and in favor of ammonia. In the last case, ammonia is relatively the higher priced and is about the condition of affairs that obtained in the early months of this year. From the above it will be observed that ammonia as a source of weak nitric acid is cheaper than saltpeter at any disparity in nitrogen cost that is likely to occur.

It is doubtful whether the overall yield of an ammonia-oxidation plant can ever closely approach the efficiency of the retort process, which in well-conducted works average 98 to 99 per cent. The catalytic oxidation efficiency to be expected under the best conditions can scarcely be more than 95 per cent and absorption efficiency 98 per cent, or an overall of 93 per cent. On a nitrogen parity, then, nitrogen for the ammonia-oxidation plant must always cost more, but this is more than balanced by sulphuric acid used in the retort process. As a matter of fact, based on prices in normal years, the nitrogen costs of the two processes would have been about the same in the past, because ammonia commanded a less price per pound of nitrogen than did nitrate. The thing to be emphasized in considering yield is the relative importance of yield gains to any probable operating economies. An addition of 1 per cent to the yield means more in dollars and cents than a reduction of 10 per cent in operation cost or fixed charges.

Concentration Cost

The concentration cost, the most important item under present conditions militating against any widespread adoption of ammonia oxidation, is a difficult matter to estimate. Nitric acid has never been concentrated in this country on the scale assumed in our comparisons, except under war conditions. The cost of this operation will probably lie between $20 and $40 per ton of HNO_3. Assuming that it can be done for the lower figure, what price can we afford to pay for ammonia in order to compete with Chilean saltpeter?

In the following tabulation the first column shows an assumed price for saltpeter, the second column the corresponding cost of ammonia at parity, the third column the price to which ammonia would have to fall to break even with saltpeter, and the fourth the estimated cost of nitric acid at the break-even condition. Yield from nitrate is taken at 98 per cent and from ammonia at 90 per cent. The conversion cost of ammonia is taken at $16 and of nitrate $32 per ton HNO_3; $20 is added to the ammonia-oxidation process for concentration.

Cost of Chilean Saltpeter, Cents Per Lb.	Cost of Ammonia		Cost of HNO_3 Dollars Per Ton
	At Parity, Cents Per Lb.	Competing Price, Cents Per Lb.	
2.0	10.5	8.8	89.00
2.5	13.0	11.2	103.50
3.0	15.6	13.7	118.00

The above tabulation shows that ammonia must be obtainable for at least 2c. per lb. less than the parity price in order to show any considerable saving over Chilean saltpeter at 2c. to 3c. per lb. as a source for strong nitric acid.

Status of Ammonia-Oxidation Process

The catalytic oxidation of ammonia gas to nitric oxide, i.e., the ammonia-conversion step in the process, may be considered as in a very satisfactory state. Obviously, from what has been said above, the point of attack in improving the process is to solve the problem of more cheaply converting nitrogen oxides to concentrated nitric acid. Seventy per cent of the plant cost is swallowed up in huge absorption towers recovering weak acid. And this weak acid must be concentrated. This problem in connection with the arc process, in which these features are greatly magnified, has received much attention abroad, as witnessed by an extensive patent literature. But not one of these proposals looks promising even on paper, and needless to say none has ever reached the commercial stage of development.

Summary

All things considered, it may be concluded as a result of this study that under present conditions, as a source for strong nitric acid, saltpeter has a slight advantage over ammonia. The conversion cost and the nitrogen cost (usually) of ammonia are less than corresponding costs of sodium nitrate, but this advantage is more than offset by the necessity for concentrating nitric acid in the ammonia process. The advantage of the retort process probably increases as the scale of manufacture decreases. If the price of ammonia falls, as is likely with the coming into production of synthetic-ammonia plants on a large scale, then the slight advantage of the retort process will disappear. It is conceivable that the time may come when it will no longer pay to import Chilean saltpeter at all as a source of nitric acid. The export duty on Chilean saltpeter is a considerable fraction of its total cost. This tax will no doubt be reduced to meet competition with ammonia, should the market for saltpeter be seriously threatened.

There are two uses for which ammonia oxidation may be profitably employed immediately. In the writer's opinion all lead chamber or "nitration" sulphuric acid plants should be equipped with ammonia converters. In this case the plant investment is relatively small. The nitrogen oxides are used as such, no absorption system of any kind being needed. The ease of control and uniformity of supply ought to be of considerable advantage to the sulphuric acid plant operation. The second possible immediate use for ammonia oxidation is for the production of weak nitric acid. There are a few industries utilizing weak acid having no use for strong acid. If the requirements are sufficiently large, it would pay to oxidize ammonia. Developments in the field of nitrogen-fixation will be watched with interest.

Combination in Condensation Products Manufacture

FOLLOWING upon the announcement in May CHEMICAL AGE of the settlement of the infringement litigation of the General Bakelite Co. against a customer of the Redmanol Chemical Products Co., whereby the latter paid damages and agreed to the manufacture of redmanol under license from the plaintiff, comes the statement that the Bakelite corporation has taken over the General Bakelite Company, the Condensite Company of America, and the Redmanol Chemical Products Company.

Judicial decision has sustained broadly the Bakelite patents to cover the molding in general of phenolic condensation products by heat and pressure and the use in such products of fibrous bodies such as wood flour, asbestos, etc. In a previous suit against George J. Nicholas & Company, the Bakelite patents covering the manufacture of varnishes and solutions also has been sustained.

The decision against the General Insulate Company and the bringing of other suits against Redmanol customers made it impracticable for the Redmanol Company to continue its business, and in order that the value of the good will, plant, and organization might not be lost, it was decided to consolidate its business including the personnel, with that of the General Bakelite Company. The Redmanol Company in the meantime having purchased a controlling interest in the Condensite Company the inclusion of that company in the merger was made possible; the Condensite Company had been operating under the Bakelite patents for several years, paying royalties as the result of suit against it in 1913.

In many respects the products of the three companies are not identical; each supplements the others in important particulars. Thus formaldehyde and "hexa" are made only by the Redmanol Co.; galalith is made only by the Redmanol Co.; chlorine substitution products are made only by the Condensite Co.; transparent material is made by the Bakelite and Redmanol Cos. but not by the Condensite Co. Their phenolic condensation products also differ somewhat in their method of manufacture. The three companies entering the merger will continue separately to manufacture and market their products which are well known under the names of Bakelite, Condensite and Redmanol; these have found wide application in the radio field, the automotive and electrical industries and for a large number of mechanical uses. All the well known laminated products such as Bakelite-Micarta made by Westinghouse, Bakelite-Dilecto made by the Continental Fibre Company, Condensite Celoron made by the Diamond State Fibre Company and Redmanol Formica made by the Formica Insulation Company, which are so largely used in the radio field and in making silent gears, are made of these materials. In their transparent condition the materials are used largely in the pipe trade and for various ornamental purposes in place of natural amber. As a result of the merger much new development and research work are already under way, from which in due course the industries using these products will greatly benefit.

This new and growing branch of the chemical industry was created and developed in the United States through the pioneer work of American chemists and engineers; the trail was first blazed by Dr. L. H. Baekeland and the pioneer character of his work has been impressively recognized by the courts. It is one of the few chemical industries that is wholly American in its inception and conduct, and which owes none of its success to foreign sources. Dr. L. H. Baekeland is the president of the new Bakelite Corporation, with Messrs. Philip Schleussner, A. Karpen and Kirk Brown, vice presidents, the latter being also general manager. Dr. Baekeland remains also president of the General Bakelit Company, Mr. Kirk Brown president of the Condensite Company of America, and Dr. L. V. Redman, president of the Redmanol Chemical Products Company. The corporations' New York offices are at 8 West 40th Street.

Hazards in the Repairs of Acid Eggs and Blowcases

By M. F. Crass

The Grasselli Chemical Co.; Chairman, Special Reports Committee, Chemical Section, Natl. Safety Council.

In chemical and other plants where acid is transferred by means of cast iron or steel blowcases, attention should be given to dangers attending repairs to this apparatus. It is well to remember that hydrogen or other explosive gases may be present in these containers should it be necessary to open them for inspection or repairs.

Particular care must be taken that no torch, lantern or other open flame of any kind is permitted near the opening of the blowcase until after the same has been thoroughly washed out, thus removing all possibility of explosive gas remaining in the blowcase. This also applies to acid pumps.

Serious accidents have occurred through workmen using an open flame torch or lantern for the inspection of acid pumps that were being taken down for repairs, without the precaution having been taken first thoroughly to flush out the acid which might remain in the acid end of the pump. In doing work of this kind rules strictly enforced should be observed, using the electric torch for inspection purposes.

Growth of the American Fat and Oil Industries

Service of the Government Scientist in Its Promotion

Dr. W. W. Skinner
Assistant Chief, Bureau of Chemistry, U. S. Department of Agriculture

FAILURE to appreciate fully the essential importance of a supply of fat in the daily diet was one of the miscalculations of the German militarists in preparation for the great war. The Germans for years were mobilizing their agricultural and industrial resources in preparation for "the day," and it seems now rather strange that when so much energy and thought were expended in this direction, the potent fact of a deficiency in oils and fats should be ignored or discounted, especially since some of the foremost German scientists had pointed out the necessity for the growing of oil-bearing plants and the domestic production of oils and fats to relieve the country from its undesirable condition of dependence upon foreign countries for an adequate supply.*

Shortly after the beginning of the war it became evident what an important aspect an adequate supply of oil was to assume. The Germans undoubtedly thought animal fats could be depended upon to furnish their needs, since German agricultural development for years had been deliberately and purposely devoted to the production and development of crops rich in carbohydrates. The error was soon discovered, but try as they might the Germans never were able to supply the deficiency, and the lack of fats and oils had a direct and important influence as one of the factors in the final outcome.

DR. W. W. SKINNER
Assistant Chief, Bureau of Chemistry, U. S. Department of Agriculture.

The lesson in this for us is a realization of the importance of fats in our economic development, and to appreciate fully the dependence of the national welfare, both in peace and war, upon an abundant and ever-increasing supply of fats and oils. The important rôle, therefore, of fats and oils in our agricultural and economic development is the justification for the Department of Agriculture maintaining in its Bureau of Animal Industry a unit for investigational and research work upon animal fats; for maintaining in the Bureau of Plant Industry a unit for the study and development of our native oil-bearing plants and for the introduction and study of foreign plants which give promise of adding to our commercial sources of oils and fats; and for maintaining in the Bureau of Chemistry a research laboratory devoted exclusively to the consideration of chemical and physical properties of fats and oils, especially those of vegetable origin, peculiarly important because of their relation to our food supply.

The Vegetable Oil Industry

The vegetable oil industry has been developed along rather empirical lines, and many problems which do not appear to have a direct industrial application have been so neglected that gaps have been left in our knowledge of some fundamental principles. It has been our conception that the research work of our Oil and Fat Laboratory can render some profitable service to the industry by undertaking a solution of some of these fundamental and basic problems than could be obtained in any other endeavor, and to attempt to fill in some of the gaps in our scientific knowledge of oils and fats and perhaps leave very largely to the industry itself the application of such newly acquired information.

It has been demonstrated time and time again that it is very important for the industry concerned to know as completely as possible the composition of its raw and finished products and that many industries have been seriously hampered, and their development retarded, until they have obtained this knowledge. A critical study of the available data showed that the alleged composition of most of the oils had not been satisfactorily determined. The data in the literature, for instance, are very contradictory in regard to the nature and proportions of the fatty acids in the oils. Recently quantitative determinations have been made in our Oil and Fat Laboratory, with an accuracy greatly exceeding any previously published results, of the fatty acids of cottonseed oil, of Spanish and Virginia peanut oil, corn oil, soya bean oil, sunflower seed oil and several oils of minor commercial importance.

It is important for oil chemists to know the limits of the variations in the chemical and physical characteristics of pure oils; i.e., to what extent the specific gravity, refractive index, iodine value, saponification value, percentage of saturated and unsaturated acids, etc., are affected by the variety of the seed, the locality in which it is grown, the soil, the climate, etc. The values for cottonseed oil, for instance, reported in the literature show great variation. Many of these published results are old determinations. The samples used have been inadequately described and information in regard to the treatment of the samples before analysis or to their authenticity is lacking. So chemists have to a degree lost confidence in the reliability of these results. The American Oil Chemists Society requested our Oil Laboratory to determine the chemical and physical characteristics of a number of authentic representative samples of the most important commercial oils. The work on cottonseed oil, and peanut oil has been completed. Forty-one authentic samples of cottonseed oil representing nearly all the cotton growing districts of the country have been analyzed. The results are surprisingly uniform in contrast to those previously published in the literature.

---

*Address before the Institute of Margarin Manufacturers, Detroit, May 24, 1922

A similar investigation has been made of the Virginia and the Spanish types of peanut oil. It has been found that there is a distinctive difference between the values for the two types, but the results for each type are uniform.

The Interstate Cottonseed Crushers' Association and the American Oil Chemists Society jointly have requested our Oil Laboratory to isolate and identify all of the constituents of crude cottonseed oil and this work is in progress. They realize that it is necessary to have this information before improvements can be made in the refining processes. The average loss when refining cottonseed oil is between 7 and 8 per cent. At least half of this loss is good oil. The annual production of crude cottonseed oil in the United States is about 1,400,000,000 lbs. If all of it were refined, a decrease in the refining loss of only 1 per cent would represent a saving of 14,000,000 pounds.

This is a large and complicated investigation which involves many problems. A preliminary study demonstrated that it was necessary first to devise an accurate method for determining the amount of oil in crude oil. Although the vegetable oil industry is relatively old there was no available method for determining the absolute amount of neutral oil in a sample of crude oil. Such a method has been devised and a description of it will be published in the near future. At present our Oil Laboratory is engaged on some other problems connected with the crude oil investigation.

Oil Extraction Methods

The methods of extraction of the oil from the raw material has been given some study to determine the efficiency of the methods and to determine the effect of the particular method employed upon the character of the finished product.

Of the two general methods of extracting vegetable oils on a commercial scale, the more common one is to subject the seeds or nuts to a high pressure in a hydraulic press or a continuous-acting expeller press. The other method is to dissolve the oil out of the material in which it occurs with a suitable solvent, usually low-boiling gasoline, and then evaporate or distil the solvent from the oil. The solvent-extraction method recovers the oil more completely. I am informed that there are several mills in this country using this method for some technical oils, but it is not favored as much here as in Europe where the method is apparently used satisfactorily for food oils. It is the opinion of some connected with the oil industry that it will in time supplant the pressure method.

Some experiments have been conducted by our investigators on the solvent extraction of cottonseed oil and on the subsequent refining, bleaching and deodorization of the extracted oil. Much valuable information has been obtained from these experiments, some of which were conducted on a semi-commercial scale. Extractions were made in copper, iron and glass vessels and it was found that iron vessels yielded an oil particularly difficult to refine to a desirable color due to the interference caused by a small amount of iron remaining dissolved in the oil, presumably in the form of some organic compound of iron.

Peanut Oil

We have been interested especially in increasing the production and the quality of peanut oil, especially cold-pressed peanut oil. This is because peanuts may be a vital factor in the control of the cotton boll weevil which in recent years has caused such serious losses in the cotton belt. Prior to 1914 very little peanut oil was produced in this country, although a considerable amount was imported. However, the domestic production increased from about 450,000 pounds in 1912 to an annual production of over 50,000,000 pounds in 1917 and 1918, while the imports increased from 7,600,000 to 27,400,000.

Peanut oil, cold-pressed from sound sweet nuts and not refined, possesses a characteristic flavor which, in the opinion of many consumers, makes it superior, especially for salads, to oils that are hot-pressed and refined. This cold-pressed virgin oil has been produced in France for many years and is highly prized there. Prior to the war practically none had been produced in this country. During the war, partly due to our efforts, several firms produced the cold-pressed oil and placed it on the market.

Owing to the troubles which the vegetable oil industry has encountered since the war, virgin peanut oil is not being so extensively produced now, but it is hoped this industry may soon be revived. It is believed that one former bad practice of American mills has been largely eliminated now; i.e., the practice of pressing peanuts without previously shelling them. The shells contain less than 0.5 per cent of oil but they readily absorb it from the kernels when pressed with them and come out of the presses with from 5 to 7 per cent. of oil. A further economic loss also occurs in that the press-cake containing shells cannot be used for human food. When blanched kernels from which the shells have been removed are employed in making oil the press-cake can be ground into meal and used with wheat, corn and similar starchy flours to form very palatable and highly nutritious cakes, gems and hot-breads.

Glyceride-Oil Resources

To supplement our supply of fats and oils many new possible sources of oil have been investigated. Such investigations are advisable also, since one of the peculiar services which chemistry can render to agriculture is the profitable utilization of what is otherwise a waste material. Large quantities of tomato seed are produced annually as a waste or by-product in the manufacture of catsup and tomato soup. This oil when refined is a suitable food oil. In Italy where the tomato-pulping industry has been developed on a large scale, tomato seed oil is a commercial product. By pressing a yield of about 18 per cent of oil is obtained and by extracting with solvent the yield is increased to 20-22 per cent. It is estimated that the equivalent of 1,500 tons of dry seed is produced annually in the United States.

Another possible source of cheap oil is to be found in the grain elevators of the northwest where many hundred tons of wild oil-seeds, principally brown mustard and charlock, are obtained in the screenings. These seeds are pressed by one or two firms and the oil used for the manufacture of soap and other technical products.

The sunflower is a possible commercial source of oil, a large quantity of oil being produced in Russia before the war from sunflower seed. The cold-pressed oil is used for culinary and for other purposes where a high grade edible oil is required, while that which is hot pressed is employed in making soaps and Russian varnishes. In 1911 more than 500 mills in the Caucasus were engaged in pressing sunflower seed, and part of the oil was exported to English refineries.

A considerable acreage in this country, especially in Missouri, is devoted to growing sunflower seed for poultry and bird seed, and occasionally an excess above that required for poultry feed is produced and sold to the oil mills. This oil is used for those purposes for which cottonseed oil is used. The output of sunflower seed can be greatly increased if the demand warrants and in time may be numbered among our important commercial oil-producing plants. Large quantities of okra seed could be produced every year by allowing the plant to go to seed after the harvesting season is over. This seed contains about 18 per cent of oil which resembles cottonseed oil. In fact the cotton plant and the okra plant belong to the same botanical family.

Cohune nut oil which is obtained from the fruit of a variety of palm tree that grows in Central and South America has been examined. The oil resembles coconut oil and can replace coconut oil for many purposes. The supply of cohune nuts is almost unlimited and several firms are now attempting to establish the production of cohune nut oil on a commercial basis. The shell of the nut is extremely hard and the lack of a machine to successfully crack the shells has held back the development. It is reported that this difficulty has been overcome now by a centrifugal machine which throws the nuts against the sides of the machine with sufficient force to crack the shells. These are only some of the supplementary sources of supply that are available and which have been given consideration and study, and some of them probably will be developed in the future and assume considerable commercial importance.

Function and Policies of Government Research

This brief summary of some aspects of Government research work in a particular field naturally raises the question as to the function of research in a governmental organization like the Bureau of Chemistry and what are or should be the administrative policies directing it.

For purposes of consideration research work has been classed as industrial research and fundamental research, but it must not be understood that the line can be drawn too finely between what has been termed pure and applied science, although there are those in the scientific world whose heads are so far above the clouds that they affect a contempt for those things which frequently follow scientific achievement in so-called pure science and which result in making the world a better and more comfortable place in which to live.

It has been aptly phrased by Dr. A. D. Little that there are those with whom "research acquires sanctity in proportion as its results seem unlikely to be of any earthly use, while research, which has for its avowed object the satisfaction of some human need, is assumed to be tainted with commercialism and to involve a lower order of intellectual merit and achievement." However, fortunately for the world, "the most self-centered investigators can make no addition to the sum of human knowledge which may not some day become a milestone of industrial progress."

It is perhaps entirely unnecessary for us to remind margarin manufacturers, engaged as they are in an industry which owes so much to both fundamental and industrial research and to whom the microscope and the analytical balance are recognized as necessary implements in the conduct and efficient control of their business, of the debt which all industry owes to science. It may be well, however, to quote the words of J. J. Carty that "in the present state of the world's development there is nothing which can do more to advance American industry than the adoption by our manufacturers generally of industrial research conducted on scientific principles. Those who are the first to avail themselves of the benefits of industrial research will obtain such a lead over their competitors that we may look forward to the time when the advantages of industrial research will be recognized by all"; and also the words of that great industrial leader, Robert Kennedy Duncan, to the effect that "The small manufacturer who is swept out of existence will often wonder why. He will ascribe it to the economy of large-scale operations, or business intrigues or what not, never knowing that his disaster was due to the application of pure science which the trust organizations and large manufacturers already are beginning to appreciate."

The work of an organization like the Bureau of Chemistry is necessarily limited in its scope by the purpose and desires of those who furnish the funds for its accomplishment. While I believe the feeling is very general among scientists, both within and without the government service, that it is peculiarly the function of the government to undertake certain fundamental activities, yet we are constrained to recognize the limitations placed upon us. We find, therefore, that the research work which we must of necessity undertake is projected upon the basis of probable profitable achievement in the fairly immediate future, although we are able to give a certain amount of attention to inquiries of a fundamental character along certain specific lines.

I feel that to governmental agencies devoted to scientific endeavor should be assigned more and more the functions involved in fundamental inquiries, and this I believe is a sound public policy, since only a governmental agency can fully afford to undertake that kind of activity the effects of which may perhaps not be measured in the present generation. Furthermore the result of every fundamental research ought to be made as completely and fully available as possible because of its bearing upon applied science, and there ought not to be secreted in the archives of private corporations data of a fundamental character which may contribute to the public good or our national welfare, for, as Dr. Alsberg, a former chief of the Bureau, has said, "without fundamental research there can be no research in applied science because after all nearly every piece of industrial research, every piece of research that has an immediate practical value is but the elaboration or the application of some fundamental principles which was developed as a rule by an investigator who was not concerned with the immediate financial returns."

As at present developed and supported, the Bureau of Chemistry is an organization in which fundamental and industrial research is pursued jointly and concomitantly. I have thought it advisable, however, to call attention to the relationship that exists in such an organization between what may be termed pure science as compared with applied science, and to enlist sympathy of industrialists for the scientific and research work which the government is doing. There has been some evidence of a hostility to a greater development of scientific activities upon the part of the government bureaus. This I think is due to a failure to understand what are or ought to be the functions of the scientific bureaus of the government and the part they should play in the industrial development of the nation. We can not in the government service undertake to solve the specific problems of the individual manufacturer but we are ever ready, so far as our resources will permit, to undertake the solution of those difficulties in which there appears to be fundamental considerations involved and where the knowledge acquired may serve a useful purpose to the entire industrial public cencerned

To this extent I wish to advise that the Oil and Fat Research Laboratory of the Bureau of Chemistry is always at the service of the fat and oil industries in a consulting capacity and whenever it is possible to undertake work which will be of service to the industry we shall be only too glad to have the opportunity brought to our attention I should like to have this industry, as well as other industries, appreciate that within the pretty well defined field of its activities the Bureau of Chemistry is ever ready to be of help in a constructive way; that in the specialized field of agriculture and food chemistry the Bureau is a storehouse of useful information which is available for the asking; that our staff consisting of over 250 chemists, bacteriologists, microscopists, physicians, pharmacologists, engineers, and other scientific and technical employees is the largest professional unit of its kind in the world; and that the services of this body are available within the limitations imposed upon us by Congress and the funds which it provides.

Improved Arsenical Insecticide

COAL tar chemistry, while occupying a large place in the public eye as typifying progress in chemical manufacture, is by no means alone in notable growth in chemical industry. The ravages of plant pests and the attainments of agricultural research in demonstrating how stupendous annual losses in crops may be controlled, have contributed to the establishment of insecticide manufacture as a branch of chemical industry of rapidly growing importance. Increased efficiency not only in procedure of production of the various insecticidal and fungicidal chemicals, but in their potency and convenience of application is the subject of general study in the industry.

It is well known that lead arsenate, both the orthoarsenate, $Pb_3(AsO_4)_2$, and the acid arsenate, $PbHAsO_4$, as well as the intermediate substance which may be regarded either as a mixture of the foregoing ortho-and acid arsenates, constitute a very efficacious insecticide for combating many forms of insect pests. Some difficulty, however, has been encountered in the manufacture of such lead arsenates, on a commercial scale, in the elimination of the arsenic, for unless the freshly precipitated arsenate be thoroughly washed, sufficient traces of the acid will be carried over into the product to render the same harmful. Particularly where the lead arsenate is made by directly reacting between arsenic acid and lead monoxide, as described and claimed in U. S. Patent No. 1,228,516 to E. O. Barstow and J. A. Cavanagh, dated June 5, 1917, wherein it is necessary, in order to facilitate the reaction, that an excess of arsenic acid be employed, the subsequent elimination of such acid from the product involves annoyance and expense.

According to the invention (Pat. No. 1,417,232), of Herbert H. Dow, Midland, Mich., instead of thus eliminating any residual or excess arsenic acid, he combines it with a suitable and relatively active basic material, as calcium or magnesium hydrate. The calcium or magnesium arsenate thus formed possesses an insecticidal value in itself, and it is not necessary to gauge the amounts used exactly to the arsenic acid remaining unacted upon by the lead compound, since an excess of either such hydrate, and particularly of the magnesium hydrate, adds to the resulting composition certain desirable characteristics for insecticidal use.

The direct reaction between lead oxide and arsenic acid to produce the acid arsenate of lead may be represented by the following equation, viz:—

$$PbO+H_3AsO_4=PbHAsO_4+H_2O$$

Another known method for making the same arsenate comprises the reaction between lead acetate and arsenic acid in accordance with the following typical equation:

$$Pb(C_2H_3O_2)_2+H_3AsO_4=PbHAsO_4+2HC_2H_3O_2$$

As previously indicated, whether the lead arsenate be formed by the foregoing or other reactions, in which arsenic acid is used as one of the reagents, or as a result of which such acid is apt to be set free, it has been necessary heretofore to wash thoroughly the precipitated arsenate in order to eliminate such arsenic acid as completely as possible, very small amounts being considered detrimental. According to Mr. Dow's invention, however, such precipitate, preferably while in the form of a sludge, i. e. before being finally filtered, is mixed with a suitable quantity of calcium hydrate, $Ca(OH)_2$, or magnesium hydrate, $Mg(OH)_2$. Mr. Dow prefers to use the latter, since the resulting magnesium arsenate is a better insecticide than the calcium arsenate; barium hydrate, $Ba(OH)_2$, also may be used. Where magnesium hydrate is used the reaction that occurs may be represented by the following equation:

$$Mg(OH)_2+H_3AsO_4=MgHAsO_4+2H_2O.$$

By determining the degree of acidity of the lead arsenate precipitate, it can be calculated readily how much of such hydrate will be required to neutralize the excess acid. and the amount of the latter can be purposely left much larger than if it were desired to make merely lead arsenate. In other words, the amount of magnesium arsenate in the final product may equal that of the lead arsenate present. It has been found advantageous to use the hydrate in such quantity as to leave an excess of the latter over that required to take up the acid in the lead arsenate precipitate; for example, such hydrate may be present as such to the extent of one-fifth by weight (dry) of the finished product.

The mixture of lead and magnesium (or other alkaline earth metal) arsenates, with addition of the hydrate of such last mentioned metal, may then be reduced to a paste by filtering either with a centrifuge or filter press, or the cake, with as much water extracted therefrom as possible, may be dried and the material reduced to a powder in any suitable form of mill or pulverizing machine. Preferably the pulverizing machine or disintegrator of the type in which stationary and revolving diaphragms are employed will be used. The powder thus obtained is of slow settling character and forms an admirable spray mixture when added to the proper amount of water and agitated, or it may be used as a dust with any suitable form of apparatus, just as in the case of dry or powdered lead arsenate.

Dr. J. C. Witt has been appointed a consulting chemist in the Bureau of Mines, and as required will cooperate in the study of some phases of Portland cement manufacture.

Markets for Low-Temperature Coal Tars

A Review of Industrial Outlets for Liquid By-Products of Low-Temperature Carbonization of Coal

By Roland P. Soule, Chem.E., Ph.D.
Department of Chemical Engineering, Columbia University

UNTIL recently the commercial carbonization of coal has been performed almost exclusively for the production of city gas and metallurgical coke. The desire for a maximum yield of gas and a hard, dense coke has led to the employment of the highest temperatures permitted by the design and material of the retort, approximating in general 900° to 1200° C. Within the past decade, however, lower temperatures of distillation have received increased attention for the production of new materials of industrial value.

Low-Temperature Carbonization

Low-temperature coal tar may best be defined as the tar produced by the carbonization of coal at temperatures below those causing an appreciable decomposition of the primary liquid products of distillation. Thus, by distilling an ordinary bituminous coal at 500° to 600° C. there are obtained a friable, free-burning coke, a gas of high calorific value and a tar characterized by low density, high content of phenols and the absence of solid aromatic hydrocarbons. The volume of gas is less than half and the weight of tar about double that obtained in ordinary high-temperature distillation. Bituminous coal, hence, is made to yield a smokeless fuel and a distillate, which upon removal of the phenols resembles crude petroleum in properties and uses.

The development to which this new industry has attained and the direction it has taken in various countries have been dependent largely upon the national resources and requirements. Thus in Germany[1] the restricted supply of petroleum and the vast deposits of a lignite which lends itself readily to exploitation by low-temperature carbonization have focussed attention on the availability of the tar thus formed as a source of lubricants[2] and liquid fuel[3].

The chief problem in England[4], on the other hand, has been the production from the "semi-coke" of a smokeless fuel suitable for combustion in domestic grates; hence the coke rather than the tar has been the primary object of investigations. In this country[5] petroleum is plentiful enough at present to make the questions of substitutes less imperative than in Germany, and low-temperature coke must compete with anthracite coal as a smokeless fuel for domestic purposes. To render such competition profitable, uses other than as fuel alone must be found for the large quantity of by-product tar formed.

Composition of Low-Temperature Coal Tars

The distillation at 500°-600° C. of a bituminous coal containing about 35 per cent volatile matter gives rise to a tar[6] of specific gravity about 1.07 at 15.5/15.5° C. Dry distillation of this tar yields 56 per cent by weight of pitch melting at 80° C. and suitable for use in briquetting, roofing and other industrial applications. The distillate contains 43 per cent. phenols, 2 per cent. nitrogen bases and 55 per cent. hydrocarbons, three-quarters of which are cyclic, unsaturated compounds. Almost two-thirds of the remaining saturated hydrocarbons are naphthenes, while the balance are paraffins. Aromatic hydrocarbons are not present in more than traces in most low-temperature tars.

As the temperature of coal carbonization is increased above 500° C. the yield of total tar and phenols diminishes, but the quantity of hydrocarbons obtained remains relatively constant. Phenol and the cresols are formed from the high-boiling tar-acids, and the secondary bases give place to tertiary compounds. The percentage of naphthenes decreases, and that of the cylic unsaturated hydrocarbons increases. At higher temperatures, above 700° C., aromatics are formed in large quantities by the decomposition of the primary phenols and cyclic unsaturated hydrocarbons.

Commercial Uses of the Phenols

Since the phenols compose nearly half of the low temperature tars distilled from ordinary high-volatile coals, a suitable industrial outlet for them is imperative. While the tar-acids of high-temperature tar consist almost entirely of phenol and the cresols in the ratio of about one to two parts by weight, low-temperature tar-acids have been found to contain only 38 per cent.[6] of phenol and cresols, or in some cases[7] even less than 2 per cent. with little or no phenol.

According to common practice at present, the tar-acids usually are not washed from the high-boiling fractions, which are sold as flotation oils, disinfectants, and sheep-dips. The phenol-coefficients of unwashed fractions of a commercial low-temperature coal tar[8] have been reported[9] as follows: Fraction 170°-230° C., 5-6; 230°-270°, 6-7; and 270°-300°, 2.5-3.5. The largest phenol coefficient corresponds to the fraction highest in total phenols.

The use of low-temperature tar-oils in the preservation of timber has been advocated [10] as preferable to high-temperature creosote. The creosote fraction of which "9 per cent. distills below 205° C. and 95.9 per cent. distills below 287° C." has been found[11] one of the most highly toxic substances commonly used in wood preservation. Low-temperature tars can be made particularly rich in this fraction by carbonizing at 500-600° C.

Dr. Soule has made an exhaustive study of the literature of the low-temperature carbonization of coal from the standpoint of its economic aspects, and of the actual composition of "Carbocoal" tar which represents the largest and most important application of low-temperature carbonization in this country (Smith process of the International Coal Products Corporation). The material is presented without prejudice or propaganda, and gives a picture of the present status of the industry so far as the development of markets for the tar is concerned.—Editor, CHEMICAL AGE.

---

[1] S. J. Lloyd, Chem. Age (N. Y.) 28, 478 (1920); W. Gluud, "Die Tieftemperaturverkokung der Steinkohle" (W. Knapp, Halle, 2nd Ed. 1921); F. Foerster, J. Gasbel. [illegible] (1920).

[2] F. Fischer and W. Gluud, Gesammelte Abhandlungen zur Kenntnis der Kohle *1*, 114 (1916); W. Schneider, ibid. *2*, 80, 145 (1917).

[3] F. Fischer and W. Schneider, Ges. Abhandl. *1*, 211 (1916); *2*, 36 (1917); F. Fischer and W. Gluud, ibid. *2*, 295 (1917); *3*, 39, 109 (1918); W. Gluud, ibid. *3*, 46 (1918).

[4] W. A. Bone, [illegible] (1921); Geo. Beilby, [illegible] 344 (1917); [illegible] 191, 252, 313 (1920); F. M. Perkin, *Gas World 69*, 385 (1918); *Eng. 106*, 746 (1918).

[5] cf. J. D. Davis, *Bur. Mines Repts. Investigations*, No. 2292 (1921).

[6] J. J. Morgan and R. P. Soule, *Chem. and Met. Eng. 26*, 923, 977 (1922).

[7] F. Fischer, *Brennstoff-Chem. 1*, 31, 47 (1920).

[8] "Carbocoal" tar from the Smith process, International Coal Products Corporation; see H. A. Curtis, *Chem. and Met. Eng. 23*, 499 (1920); *J. Ind. Eng. Chem. 13*, 23 (1921); G. H. Thurston, *J. Soc. Chem. Ind. 40*, 51T (1921).

[9] Walter Runge, Chem. Age (N. Y.), *30*, 9 (1922).

[10] F. P. Coffin, *Gas Age-Record 48*, 97 (1921).

[11] C. J. Humphrey, Bull. 227, U. S. Dept. Agriculture, p. 22.

It is not yet known[12] what contituents in the tar-acids are responsible for their bactericidal action. The action of toxic agents appears to be specific; those highly poisonous to certain organisms are only moderately so to others. The toxicity in amount required to kill *fomes annosus* increases as follows[13]: phenol 0.10 per cent., *o*-cresol 0.07-0.08 per cent., *m*-cresol 0.06 per cent., iso-amyl phenol 0.05 per cent., mesitol 0.05 per cent., butyl phenol 0.04-0.05 per cent, ethyl phenol 0.04 per cent., xylenol 0.04 per cent., propyl phenol 0.03 per cent., and beta naphthol 0.02 per cent. More than half of the distillate from a 500°-600°-coal tar is composed of the highly toxic cresol and xylenol fractions. The practical effectiveness of a wood-preservative, however, depends not only upon its toxicity but also upon its volatility and its solubility partition between the "barren oil" and water[13].

The use as fuel of the phenol-containing fractions of low-temperature coal tars has made considerable progress in Germany. Lohberg gas coal (39 per cent. volatile) yields [14] 20-30 per cent. motor spirit (to 225° C.) and 25-30 per cent of fuel oil (225°-300° C.). It is stated, however, that the motor-spirit attacks metals to a slight extent. This has been disputed[15] by Dr. F. Fischer, director of the Kaiser-Wilhelm Institute for Coal Research, who states that the sulphur compounds among others may be responsible. A tar-oil (175°250° C.) containing about 45 per cent. phenols has been used[16] without trouble in an oil-burning engine. The production of light motor fuels by "cracking" low-temperature phenols in the presence of hydrogen (and thus paralleling coke-oven conditions) to form benzene, toluene, and xylene[17] or the higher cyclohexanols[18] has also been advocated.

Formaldehyde condensation products of the type of "bakelite" and "novolak" have been successfully prepared[19] both from the phenols and the phenol-containing fractions of low-temperature coal tars. Doubt is expressed[7], however, that this market will be able to absorb a very large proportion of the great production of phenols in low-temperature carbonization, although their extreme cheapness will undoubtedly stimulate their use in a wider variety of ways. The recent development o the Bregeat process[20] suggests extension o their use in the recovery of volatile solvents.

It has been pointed out[21] that coumarone resin cannot be produced directly from low-temperature coal tar. If the phenols from such a tar are first "cracked" to form oils insoluable in alkali, however, coumarone resin can be made in the usual manner from this non-phenolic fraction. Such a procedure simply duplicates the mechanism of secondary carbonization reactions occurring in the distillation of coal, since the monocyclic aromatic hydrocarbons of ordinary coal tar owe their origin chiefly to the decomposition of the phenols of the primary low temperature tar[6].

Commercial Uses of the Hydrocarbons

The hydrocarbon fractions of low temperature tars do not deposit crystals on standing. After removal of the phenols and nitrogen bases they remain freely liquid even when cooled to -25° C., demonstrating the absence of solid aromatic hydrocarbons, such as naphthalene or anthracene. Cyclic unsaturated (hydroaromatic) hydrocarbons comprise the second largest group in most low-temperature tars. Thus the distillate below 325° of a commercial sample[8] contained[6] 42 per cent. of these compounds, while the tar-acids amounted to 43 per cent.

The problem of the utilization of the hydrocarbon mixture is essentially that of disposing of the entire neutral oil. It has been pointed out[6] that the naphthenes and paraffins of the tar distillate are of the same nature and are found in the same portion as those occurring in kerosene refined from mid-continental petroleum. These saturated hydrocarbons have insufficient value in themselves to justify any attempt to isolate them at the sacrifice of the prepondering unsaturated hydrocarbons.

The absence from the mixture of aromatic hydrocarbons in any considerable quantity makes the tar of small value to the producer of dye- and drug-intermediates. It has been found[22], however, that simple "cracking" is capable of producing a good yield of aromatics. On the other hand, the indirection of such a procedure can be justified only when the production of the semi-coke, or smokeless fuel is the primary purpose of the low-temperature carbonization.

The most promising field for this hydrocarbon mixture seems to be that of liquid fuel[3]. Here the problem becomes very similar to that of the shale-oil industry[23]. The oil is less volatile than that desired at present for internal combustion purposes, and presents many problems in efficient refining. A water-white product that will remain colorless and not yield black deposits on standing can be produced by sulphuric acid treatment only at the sacrifice of a large proportion of the oil. It is not improbable, however, that our waning petroleum resources will compel the development of engine design to accommodate the fuel, as well as processing the fuel to fit the engine.

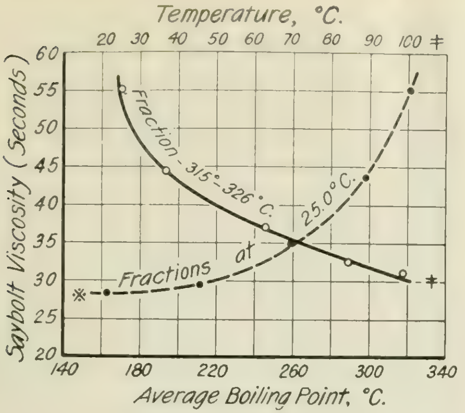
The question of lubricants[2] is one second in importance at present only to that of liquid fuel. The Saybolt viscosities at 25.0° C. of the first fractions of the hydrocarbons of a commercial low-temperature tar[8] and the variation with temperature of the highest fraction (315°-326° C.) are shown in Fig. 1. It is apparent that the hydrocarbons boiling below 326° after removal of the phenols have only slight lubrication value. The readiness with which most of this oil can be made to polymerize suggests, however, that lubricant can be made from it by secondary reactions[24].

It is evident from Fig. 1 that the natural viscosity of the neutral oils increases very rapidly in the fractions boiling above 300° C., which should therefore have marked lubricating properties. The distillate above 300° consists[6] almost entirely of unsaturated hydrocarbons with a diminishing amount of relatively inert phenols. The importance of unsaturated molecules in lubricants has been emphasized repeatedly. A special interest attaches to this fact in view of recent investigations[25] of "oiliness" and the theoretical relationship between unsaturation and the lubricating properties of an oil. The value of a lubricant depends

---

[illegible]

[illegible] p. 27 (1915).



Viscosities of Fractions of Low-Temperature Hydrocarbons.

upon its ability to reduce frictional resistance between rubbing surfaces. Different oils of the same viscosity may or may not possess this property, which has been described as oiliness. It appears, however, that oiliness "is an effect produced by the lubricant upon the metallic surfaces with which it is in contact, rather than a property dependent upon any particular physical property of the lubricant"[25]. Since it has been shown that this effect is enhanced by the presence of unsaturated compounds, it is to be expected that the high-boiling distillates of low-temperature tars have a considerable lubricating value.

Some studies have been made[26] of the oxygen absorbing power of a low-temperature tar in comparison with that of linseed oil. It was found that the "tar films are decidedly thinner—and that the time of drying is from two to three times that observed in the case of linseed oil." This oxygen absorbing power of the hydrocarbons is claimed[10] to add to the preservative properties of low-temperature tar-oils by virtue of the formation of impervious varnish-like films in the surface layers of the timber.

Improved Procedure in Glucose Manufacture

INDIAN corn is composed of starch, germ, hull and fibre, certain soluble substances and protein, which latter ingredient is sometimes termed "gluten," although this term is applied less appropriately to corn protein than to the protein of wheat since the corn protein is not at all glutinous in character. In the manufacture of starch from corn the soluble substances of the grain are eliminated to a considerable extent at least by the steeping of the grain, the primary purpose of which is to soften the kernel so as to facilitate the separation from the starch of the germ, the hull and fibre, and the bulk of the protein, these separating operations being effected by mechanical means in the order named.

The separation between the starch and protein is ordinarily accomplished by "tabling" the starch and protein magma on inclined starch tables upon which the starch granules subside and over the ends of which the protein and water tail-off. By this method, which is probably the only method of making the separation between starch and protein that has been found practical for corn starch, a large proportion of the protein is removed from the starch. But it never has been found possible to remove all of the protein in this, or, in fact, in any other manner. All commercially produced corn starches, even when subjected to repeated tabling (and this, of course, adds considerably to the expense of manufacture), contain some quantity of protein. The presence of this residual protein, as the impurity may be termed, even when it is reduced to a minimum, gives rise to difficulties and inconveniences of a very serious character when the starch is manufactured into its conversion products, such, for example, as glucose or grape sugar.

Apparently the protein molecule is unstable and liable to disassociation under the influence of the heat and acid used for conversion of the starch. It is the presence of the residual protein in the starch which gives the liquor from the converters its brown color and which tends to impart to glucose and grape sugar made from corn the bitter taste characteristic of these products. The ordinary tabled starch will contain at least 0.5 per cent. of protein (computed by weight of dry substances). It may contain considerably more. Even if the starch has less than this percentage of protein the converted liquor made therefrom will be constantly discolored, the deepness of the coloring depending somewhat upon the temperatures employed, the amount of acid used and the length of the converting operation.

As the market requires glucose and sugar as light in color as possible it has been customary in making these products to filter the converted liquor through bone char. This operation will remove the brownish color, unless the liquor has been too much discolored, but the expense of the procedure is considerable and it does not entirely eliminate the bitter principle from the product nor does it entirely remove from the product all of the protein or its derivatives. If these remain, discoloration is likely to recur after the product has stood exposed to the atmosphere or when it is heated.

In the manufacture of corn sugar, using the term as distinguishing the solid conversion product from the syrup known as glucose, the presence in the starch of the residual protein involves still further disadvantages. In the manufacture of corn sugar in a dry or pulverizable state it always has been necessary to sacrifice a part of the yield of the conversion step in the form of mother liquor or "hydrol," which is pressed out and is of little commercial value. Apparently the presence of the protein in the starch prevents any approximation to complete conversion of the starch into dextrose and hinders complete crystallization of the converted product. It seems to be the fact that the greater the percentage of residual protein in the starch the higher the percentage of hydrol. The hydrol contains a considerable amount of dextrose. As a result the yield of sugar, in a salable form, falls considerably short of the actual amount of dextrose produced by the conversion of the starch. Moreover, the operations involved in the crystallization of the dextrose and the separation of the crystals from the mother liquor are complicated, expensive and require considerable time and factory floor space. Adolph W. H. Lenders and Paul W. Allen, of Penick & Ford, Ltd., Cedar Rapids, Iowa, seek to avoid all these difficulties by subjecting the starch, precedent to converting, to a treatment which will eliminate all or substantially all of the residual protein impurities which, as stated, are incapable of removal by any known mechanical means capable of utilization on a commercial scale. This elimination of the protein impurities is accomplished by subjecting the material mixed with water to a suitable treatment which makes the protein soluble without appreciably affecting the starch. The protein dissolves in the water and the starch is thereupon removed from the water and dissolved protein in any suitable manner.

This treatment consists in subjecting the material in suspension in a relatively large volume of water to the enzymic action of proteolytic bacteria under conditions which bring about the solubilizing of the protein. It is well known that the enzymes produced by bacteria are the active agents for bringing about reactions of this character. The protein is decomposed or split but preferably not deeply enough to produce any appreciable amount of foul gases. The bacteria used are members of the *Bacillus putrificus* group, the particular organism best calculated to serve the purpose being Group No. B. 121.1233111 in accordance with the descriptive chart of the Society of American Bacteriologists endorsed by the society for general use at the annual meeting December 31, 1907.

In order to get the best results the starch, after being inoculated, is allowed to settle, the liquid containing the products of bacterial action withdrawn, fresh water mixed in, and these operations repeated from time to time until the liquefying action of the bacteria is complete, the material being maintained at a temperature most favorable to the growth and activity of the germ, viz. 100-105°.

Procedure

The process of purification may be carried out as follows: The starch from the starch tables is mixed with water to a density of, say, 21° Baumé, the water being warmed so as to give the mixture the desired temperature of 100-105° F. The starch is placed in a vat provided with suitable agitating means and is inoculated with a culture of the bacteria and stirred for about 2 hours. It is then allowed to stand for 20 hours, more or less, to give the starch a chance to settle. The water is then drawn off and fresh water added and mixed with the starch and the mixture kept in agitation for another 2 hours or until the starch is put into suspension, after which the starch is allowed to settle, the water decanted, and fresh water added as before. Each of these series of operations will thus consume 24 hours and the whole operation may require from 6-12 days, more or less, in accordance with the amount of protein in the starch. After the last decantation, it is desirable to wash the starch thoroughly with water although this washing operation may not be essential. It has been found that to get the best results the starch liquor after inoculation should have at the start of bacterial action at least two million bacteria per cubic centimeter. Test shows that there is progressive, if somewhat irregular, diminution of the protein content of the starch from day to day.

To illustrate the importance claimed for the inventors'* considered as an improvement in the manufacture of sugar, Messrs. Lenders and Allen describe the steps necessary to manufacture the purified starch into a sugar of relatively high dextrose content.

The starch is diluted with water to a density of approximately 10° Baumé, is acidified with hydrochloric acid to give an acidity of 0.12 per cent, and is then converted. The conversion is carried on preferably at a relatively low pressure, 20 pounds per square inch, in a closed steam-jacketed kettle and may require from 1½-2 hours. The converted liquor is cooled, neutralized, kiesel-guhr added, filter-pressed to remove suspended particles, and then concentrated in a vacuum pan to the density of substantially 42° Baumé. It is entirely unnecessary to bone-char-filter the converted liquor either before or after evaporation. After the liquor has been evaporated it is cast upon the floor or in mold pans and allowed to crystallize. Seed crystals may be used for initiating the crystallization. The entire yield of the conversion step will solidify and the solid cakes may afterwards be broken or ground and the materials dried in the form of granules or a powder.

Messrs. Lenders and Allen depart somewhat from the common practice with reference to the crystallization of the product and have found that the time consumed for the crystallization of the material may be considerably reduced by beating the concentrated liquor for several minutes so that it will have the consistency of whipped cream. After this the sugar is run into pans and dried and ground as before mentioned. The step of beating the converted liquor is the sole invention of Mr. Allen and the subject of application Serial No. 277,579 filed February 17, 1919.

By the method outlined it is possible to manufacture a corn sugar almost perfectly white in color, without bitter taste and which may contain, if desired, up to 98 per cent. of dextrose. While of particular utility in the manufacture of products from Indian corn, because of the peculiar difficulties in making a complete separation between the starch and protein of this grain, the method may be employed to advantage in the manufacture of starch and starch products from other amylaceous materials.

Research Fellowships in the Agricultural Use of Sulphur

The National Research Council announces for the next academic year a number of fellowships for fundamental investigations on agricultural applications of sulphur, the funds for which have been provided by a grant from the Texas Gulf Sulphur Co.

These fellowships, each carrying an annual stipend of approximately $1,000, will be administered by a special sulphur fellowship committee of the advisory board of the American Society of Agronomy, in conference with the executive committee of the division of biology and agriculture of the National Research Council. Inquiries and applications should be addressed to the Sulphur Fellowship committee, National Research Council, Washington, D. C.

It is proposed that the work to be prosecuted under these fellowships will include investigations on the value of sulphur in the control of potato scab, nematodes, soil insects and sweet potato disease; also the value of sulphur as a fertilizer for alfalfa and other legumes and the effect of sulphur on alkali soils.

Applicants for the fellowships must be graduate students in universities and colleges or competent members of experiment station staffs.

---

* [illegible] May [illegible], 1922

The Fine Art of Finding a Job

A Brief Treatise on Salesmanship of Technical Service by the New York Volunteer Employment Committee

THE experience gained by this committee in interviewing hundreds of employers and thousands of employees seems to prove that the average unemployed technical professional man of today passes through three stages before making a new connection.

The first may be likened to that of a chicken which has recently been deprived of its head. First comes the severing blow of discharge quickly followed by a wild outpouring of hastily prepared and ineffective letters, fit only for the waste basket, and a mad aimless rushing hither and thither after jobs for which the unfortunate is totally unfitted. Should anyone dare to offer the kindly suggestion that he is reaching for something beyond his grasp, the would-be applicant sees a diabolical attempt to keep him out of work and bullheadedly insists upon having his way; blindly ignoring the fact that he is wasting his time and hurting the Bureau.

Meeting with no success he is overcome with an enervating feeling of self-pity, and proceeds to give a most excellent imitation of Sir Isaac Newton discovering the law of gravity. While the achievements of great scientists are always worthy of imitation by engineers, there is very little chance these days of a pretty little cotton-wrapped job gently falling into the lap of any man. At this stage he spends a goodly part of his time in composing bitter arraignments of the inefficiencies of the Bureau (ignorant perhaps of the fact that his contribution towards its support amounts to just 25 cents per year), and is quite firmly convinced that the hand of both God and man is turned against him.

Finally, he reaches the third stage where he decides to quit imitating the ostrich, withdraws his head from the sand of ignorance and personal prejudice and faces the cold hard facts in the light of day. Now something can be done to help him.

Salesmanship

To get a job one must sell one's services. Unfortunately the prospect of having to go out and attempt a sale seems to throw most technical men into a blind unreasoning panic. This is due, doubtless, to a childlike acceptance of that most fallacious and weak-minded, though generally accepted, statement that an engineer cannot make a good salesman. And why not, pray? Surely a man who understands human nature, knows his goods, thoroughly believes in them, and displays a reasonable amount of enthusiasm in presenting them should stand a good chance of making a sale.

The trouble with the unemployed technical man is that he doesn't know his goods, consequently hasn't a strong belief in them and instead of presenting them with a show of sincere enthusiasm, tries to cover these defects with a bluff; thus inevitably appearing either as a "know it all" or a charity seeker.

The Buyer

When an employer desires a man to fill a specific opening he usually has a more or less well defined idea of the kind of man he wants, and that applicant is successful who most closely approximates that ideal. True it is, that one occasionally meets a man who doesn't seem to know what he wants and this is really the easiest type of man to deal with, providing the applicant knows and believes in himself. For the employer's nebulous ideas can often be crystallized into a form according almost exactly with the qualifications of the applicant.

Unfortunately most applicants seek merely a certain salary and are ready to take almost any kind of a job which meets this requirement. Hence to a prospective employer applicants appear weak, doubtful of their own capabilities and create a most negative impression. Remember, always, that when a man is hired, a contract is made, and a contract has been well defined as "a meeting of two or more minds." How then can two minds meet when only one of them has a well defined set of ideas?

Self-Scrutiny

The first thing for a man to do is to draw up a detailed list of his qualifications—personal, educational, practical. But let him play fair with himself and note both strong and weak points. Here is a chance to make progress, for ambition will force every normal man to seek remedies as soon as he recognizes his weaknesses.

Next, he should whip this detailed list of qualifications into a clear, concise, forceful experience record which will show him up in the best light possible. This is the hardest part of the whole task and will require not an hour, but more often days of hard, consistent effort; but when properly carried out it creates a wonderful feeling of confidence, and gives him a sharply defined idea of his size as pertaining to any job he goes after. As a result he no longer wastes his time and efforts in madly chasing after a wild series of impossible jobs, but settles down to a very determined and much more frequently successful hunt for a job within his capabilities.

Incidentally this is an ideal time to take some thought of the future and decide what one would like to be ten or twenty years from now, thus gaining an idea of how far one has progressed along the desired path, and what steps must still be taken to attain the goal. One should, of course, set up a high standard, but not an impossible one, and what that may be each man must determine for himself.

This mode of procedure enables a man to make a progressive effort to gain a job which is within reason and which will enable him to gain additional valuable experience. He has now reached the point of knowing what he wants, why he wants it and why he should have it. A man in possession of these facts is a hard individual to turn down, and more important still, he has acquired confidence.

The Market

Logically, the next step to take is to find a market for the goods. This is where the Bureau, advertisements, letters and personal tips should be used. But bear in mind, these are media only and none of them will or can get the job itself—they merely put one in touch with it.

Most jobs, and particularly the good ones, are "by letter," so it behooves the applicant to give heed to what constitutes a successful letter. To begin with, avoid wasting a paragraph or even a sentence telling how the

---

The New York Volunteer Employment Committee is made up of men registered with the Engineering Societies Employment Service and is engaged chiefly in canvassing employers of technically trained men in and about New York City for the purpose of bringing to their attention the valuable service offered without charge by the bureau.—Editor, CHEMICAL AGE.

job was located—the heading does that. Set forth the qualifications in general but forceful terms—the experience record will give the details and proof. Above all, be concise, for if you really know—don't think or hope—you will fill the job, your letter will show it. But no man, not a genius can dash off an effective letter in an hour. A successful letter is well worth several hours' effort.

Even after composing what appears to be a good letter, its value must be tested in the open market—and the first attempt is rarely successful. Persistence plus knowledge and confidence must inevitably gain the day. When seeking a particularly desirable job, it is excellent practise to analyze each item of the general experience record and consider its exact bearing on the job in question. Then by re-writing the record, one is in a position to give to each phase of the experience its proper relative degree of prominence, thus creating a much more favorable impression than would be the case were the general record offered.

The Interview

Finally, comes the interview. Its success will be dependent upon the personal impression, intelligent expression of requirements and qualifications and mutually satisfactory terms. Physical appearance counts for a great deal. Some are naturally gifted, others are not. But one's natural inclinations usually incline one towards a line with which the physical appearance accords.

One does not pick a dray horse for the race-track. So look to the neatness of clothes, face and shoes, and let the guest beware of his manners. Watch carefully the questions and answers, for the tongue has often slipped many a man out of a good job. And lastly endeavor to be reasonable in one's demands, for if the employer doesn't use good business judgment in dealing with the employed, the latter will not long have a job. The following summary will supplement the foregoing remarks. It is hoped that both will cause the man who is looking for a job to *think well,* before he acts, and to remember he must act *intelligently* if he is to succeed in his quest.

Summary

1. Decide on what you want.
2. Make sure your qualifications give you an even chance of getting it. But don't think 100 per cent. is necessary. Perfection doesn't exist.
3. Don't go after a job unless you mean business.
4. There are three factors to every job, viz.: Advancement, experience, salary. Don't ignore the first two.
5. Remember that the *Job* gets the salary—not the applicant's qualifications.
6. Job-getting is selling one's services. The successful salesman knows his product thoroughly. Study your goods.

Letter-Writing

1. The object of a letter is to get an interview. Letters don't get jobs.
2. Padding of payrolls is a felony. Padding of letters is equally dangerous for the job-hunter.
3. A letter must arouse interest, create desire, prove the case, convince the reader that an interview will be profitable. Hence: Be as brief as is consistent to prove your claims. Make no claims not backed by the experience record. Always include the experience record.
4. Attractive packages improve the sale of goods. Therefore, typewritten letters on plain business stationery are better than long hand ones on club or personal stationery.

Interviews

The interview is "The day in court." Getting it is only half the battle. When being interviewed:

1. Be fully confident of your worth—but not presumptuous.
2. Be sure you want the job and be ready to prove why you should get it.
3. Ask a fair market price for your goods. Don't profiteer. Don't be a philanthropist.
4. Assay the three elements—Advancement—Training—Salary—and be guided by the sum of the three in accepting or declining.
5. Leave in a pleasant hopeful manner if the job is not decided then and there.
6. A letter of acknowledgment of the courtesy of an interview is good policy following a promising call.

Finally

Maintain the proper mental attitude. Don't let your morale slump. Nobody wants a grouch or a man who is not sure of himself.

Montana Law Restricting Use of Natural Gas in Carbon Black Manufacture Declared Unconstitutional

The Gas Products Co., a Montana corporation engaged in utilizing natural gas in that state in the manufacture of carbon black, brought action against the state attorney general to restrain him from the enforcement of a statute of the 1921 legislature forbidding the use of natural gas for carbon black manufacture.

The Supreme Court of the state, in an opinion by Associate Justice Albert J. Galen, declared the law unconstitutional and asserted that restriction of the use of natural gas for making carbon black is confiscation of property without due process of law. Natural gas, or oil, the court holds, is real property, subject to the uses to which the owner might put it, and not subject to such regulation by the state as is provided for in the law complained of.

Under the provisions of the state constitution "natural gas is not a product which may be conserved and preserved by law as a thing in which the people have a common interest, as flowing streams, wild animals, etc."

It is also held that the plaintiff company, which invested $200,000 in Fallon County, near Baker, Mont., cannot be deprived of its property by legislative enactment. The act under consideration, the court says, "is pernicious, unreasonable and confiscatory in character, violates the constitutional rights of property of the plaintiff; and therefore, we have no hesitancy in declaring it unconstitutional."

Commercial Solvents Corporation, 17 East 42nd St., New York, with plant and general offices at Terre Haute,, Ind., for the production of butanol from corn by fermentation (Weissman process), is offering 40,000 shares of cumulative Class A stock, no par value, to yield about 9 per cent. The stock is entitled to cumulative dividends at the rate of $4 per share a year, and is convertible on any dividend date into Class B stock share for share. With the issue of the new stock the company will have outstanding 40,000 shares of the cumulative convertible A stock and 40,000 shares of no par value Class B stock. It has no funded debt. P. J. Mumford, president, states that net profits before Federal taxes for the quarter ending June 30, 1922, six weeks estimated, will aggregate $140,181, compared with $120,195 in the preceding quarter.

Concentration of Sulphuric Acid

A Description of Modern Methods, Including the Concentration of Sludge Acid and Acid-Proof Masonry Construction

By Peter S. Gilchrist

President, Chemical Construction Co.

CONSIDERABLE study of sulphuric acid concentration has been made by different chemical engineers during the last few years, stimulated, to some extent, by the heavy demand occasioned by the late war. Instead of small units of 5-10 tons capacity per day, we now think of units of 80-125 tons capacity per day, the large units requiring no more labor than was required for the smaller units, and at the same time, operating with greater economy of fuel.[*]

The advent of the Glover tower gave chemical engineers the idea of using the principle of the Glover tower for the higher concentration of acid, and today the tower system and the combined tower and surface evaporation systems of concentration are the methods in the most general use, especially for concentrating chamber acid. Owners of plants for the concentration of chamber acid, or the reclaiming of contaminated sulphuric acid, are today looking for equipment that will operate without too many unnecessary shutdowns for repairs, and that can be operated with the least possible labor.

The principal feature to be considered when planning the installation of a concentrator are the following:

(1) A reasonable investment for the owner.
(2) Durability of the equipment.
(3) Minimum labor.
(4) Low consumption of fuel and power.
(5) High recoveries.
(6) Elimination of waste fumes.

The use of fuel oil as a heating medium for evaporation and the perfection of the oil burner so as to get absolute combustion, have made it practical to apply. the direct heating principle for evaporating without discoloring or contaminating the acid. The use of more permanent construction materials has reduced to a minimum the maintenance and labor costs. For instance, a vast amount of concentrating is now being done in baths by the direct heating principle and in towers where the principal item of construction is acid-proof masonry. The adoption of acid-proof iron for overflows and transfer lines for hot strong acids has been very advantageous.

In this paper the antiquated pan, still and bottle systems are eliminated, confining the description to the following systems: (1) Cascade; (2) Tower system; (3) Combination surface evaporation and tower concentration; and (4) Hot-air submergence type. These four methods, and especially the last three mentioned, are the ones used principally in modern plants.

Continuous Cascade System

In this type of concentrator we have the application of indirect heat for evaporation. The heat can be supplied either with oil, gas, coal or coke. The combustion gases do not contaminate the acid as the pans are heated from the underside, the heat gases not coming in direct contact with the acid. This type consists of a series of pans, or dishes, in several rows, each row a step higher than the preceding one in order that the acid may enter at the top pan and overflow by gravity from one pan or dish to the other until it is sufficiently concentrated. The heat is applied at the acid-outlet end, at which place is located the lowest row of pans or dishes. These pans or dishes are supported on open seats which are directly exposed to the heat.

The three or four lowest dishes in each series are protected by bowls, from the direct heat, so as to prevent violent ebullition and spurting of the acid. The acid vapors are drawn off by an exhauster, and condensed. The loss by fumes is apt to be greater with this system than with the tower system. The cascade apparatus is designed so as to get at each dish or pan readily in case of breakage, which interrupts the flow of acid, in addition to the loss of acid sustained. The advent of the vitreosil dish, which has a very low coefficient of expansion, has very materially reduced the losses by breakage. It is claimed that the breakage of vitreosil dishes is about 5 per cent and the pans 1 per cent.

Messrs. A. E. Wells and D. E. Fogg[*] described a 10-ton plant with one hundred dishes of 12 inches diameter and 60 preheating pans 24 inches by 12 inches for concentrating acid from 60° to 66° Bé. They give the cost of concentration as follows:

Coal, 17% @ $5.00 per ton	$0.85
Labor	1.25
General expenses and repairs	1.00
Losses 4% of acid assuming 60° Bé. acid @ $8.00 per ton	30
Operating cost per ton of 66° from 60° Bé.	$3.40

For comparison with other estimates following, in this estimate, it is to be noted that 17 per cent of a ton of coal, or 340 lbs., is equivalent to 245½ lbs. of oil (32.3 gallons). Then 32.3 gallons oil at 4c per gallon equals $1.29 or an increase of 44c in fuel cost per ton of acid, making the total cost on the basis of Messrs. Wells' and Fogg's figures $3.84 per ton.

Combination Cascade and Tower System

Combinations of cascade and tower systems have been used. An installation at Baltimore in 1916, with 12 iron pans of 36 in. diameter, in two rows, produced 23 tons of 66° acid per 24 hours from 54° Bé., the acid entering the top pans being 57° Bé. at 290° Fahr. Actual operating cost per ton of acid is as follows:

Fuel oil, 19.5 gallons @ 4c	$0.78
Labor	.71
General expenses and repairs	.85
Losses, 10% of acid assuming 60° Bé. acid @ $8.00 per ton	.80
Operating cost per ton of 66° from 54° Bé.	$3.14

Tower System

In this type of concentrator the entire concentration is done in a tower. The tower is partly packed with suitable tower filling. The combustion gases enter at the bottom of the tower and as they ascend they meet the down-coming acid in the tower, the exit of steam and gases being made at the top of the tower. The weak acid is sprayed in at the top, and the strong acid settles in a basin at the foot of the tower. It is interesting to note that in this type of concentrator the entire volume of hot air comes in direct contact with the acid, thus keeping the strong acid at its actual boiling point. This has the disadvantage that the hot gases of combustion play directly on the arches and tower packing before the gases have much chance to cool.

---

[*] Presented at Niagara Falls meeting, June [illegible], 1922, American Institute of Chemical Engineers.

[*] The Manufacture of Sulphuric Acid in the U. S. Bulletin 184, Issued [illegible] Bureau of Mines.

Depreciation of the apparatus for this method of concentration is very reasonable, due to the tower being made of acid-proof masonry work, but it is understood that the lower part of the packing has to be renewed occasionally as it will burn out due to the high heat. Results from this method are claimed to be one ton of 66° acid from 60° with 11 to 12 gallons of oil.

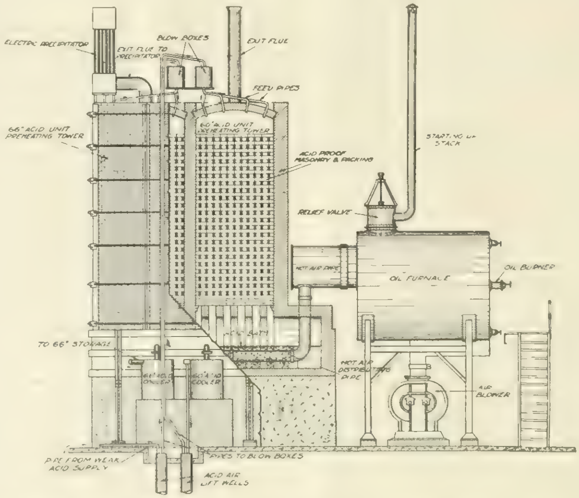


Diagram of Equipment of Chemical Sulphuric Acid Concentrating Process, Sludge Acid Type.

Combination Surface Evaporation and Power System

It was found years ago that the method of surface evaporation, or direct heat application, was much more efficient than the indirect application of heat, such as with pan or still systems. Surface evaporation was not very practical before the advent of the oil burner, as absolute combustion is essential to success.

The principle of tower concentration is well known. In this combination type concentration is accomplished (1) by surface evaporation, (2) by tower evaporation and preheating. The weak acid is sprayed in at the top of the tower. The upper portion of the tower does the preheating and the lower portion the preliminary concentration. The tower is packed with suitable packing materials. The acid falls from the tower into a long horizontal flue containing a bath of acid over which the hot gases pass. The combustion gases enter the flue at the acid-outlet end and pass along the surface of the acid to the foot of the tower where they pass up through the interstices of the tower packing, meeting the down-coming weak acid. The tower is of sufficient height and size to utilize the remaining sensible heat of the combustion gases. The greater part of the concentration is done in the pan flue where the strongest acid is made. The bath of acid is about 9 in. deep, and as the hot gases are brought into immediate contact with the surface acid, the acid takes up the heat much better than when the acid and heat are separated by metal plates as is the case with cascade or pan systems. Evaporation is very greatly assisted by the direct heat over the acid, the draft removing quickly the vapors formed. The finished acid leaves the concentrator at the furnace end, temperature about 50° F. below the actual boiling of the acid, which is strong evidence of the efficiency of this system. Because of low heat reaching the tower, the apparatus itself has a very long life and the tower packing proper will last as long as any of the apparatus.

The principal apparatus of this concentrator consists of a combustion chamber, a concentrating pan flue, concentrating tower, filter and scrubbing tower, all of which are constructed of acid-proof masonry, well braced with steel framing and supported on concrete or brick foundations at a suitable height above the ground level. On top of the concrete foundations, masonry-lined lead pans are used, on which are built the masonry walls. The concentrating tower is packed with checkered brick, quartz, or other suitable packing and the filter tower is packed with 3 in. special rings, or quartz. If the packing materials are carefully selected, the distillate from the tower can be sold for battery acid and other similar uses.

Two 50-ton units of this type concentrator were installed nearly five years ago at Bayonne, New Jersey, for the Standard Oil Company. Recent figures have shown that over this protracted period of operation the consumption of oil was from 10 to 11 gallons per ton of 66° acid starting from 55° Bé. During a period of a little more than four years, over 140,000 tons of 66° acid were turned out with a repair and upkeep cost of less than $10,000. This gives the cost of repairs and upkeep at 7c. to 8c. per ton of 66° acid. One man per shift operates the entire plant. The labor per ton for large plants is naturally less than for small plants. Cost of operation is as follows:

Fuel, 11 gallons @ 4c	$0.44
Labor	.12
General expenses and repairs	.30
Losses 3 1-2% based on $8.00 per ton of 60° acid	.28
Operating cost per ton of 66° acid from 54° Bé.	$1.14

This system of concentration is especially adaptable for making 98 per cent. acid, on account of construction. The apparatus easily can withstand the higher temperatures encountered in the final stage of concentration. In bringing acid to 98 per cent. strength, provision has to be made for taking care of the additional distillate, and naturally the output of acid decreases and the oil consumption increases.

Operation of Hot-Air Submergence System

Especially in the concentration of sludge acid it is necessary to accomplish concentration at the lowest possible temperature because the acid to be concentrated is contaminated with carbonaceous matters which, in company with strong hot acid, quickly causes the breaking up of the acid into SO_2, it being well known that one pound of carbon will break up sixteen pounds of acid. Heretofore, the pans have been used mostly for the concentration of sludge acid, but the cos is almost prohibitive, and in some cases when using the pan system, the cost of concentration exceeded the cost of the new acid. The cost of concentration by this new method of hot-air submergence, in some instances, has reduced the cost of the 66° recovered acid to one-third or one-fourth the cost of new acid.

This hot-air submergence type of apparatus is designed to concentrate any kind of sulphuric acid, and especially separated sludge acid of any quality. The underlying principle of the process is concentration by blowing hot air, at a temperature of about 1200° F., through the acid. The process is continuous except that when handling sludge acid concentration must, for reasons stated later, be carried out in two stages. Confining the principle of concentration to sludge acid only, the concentration of sludge acid from oil refineries, the operation is carried out in two stages, in order to avoid frothing and foaming due to this decomposition of the hydrocarbons.

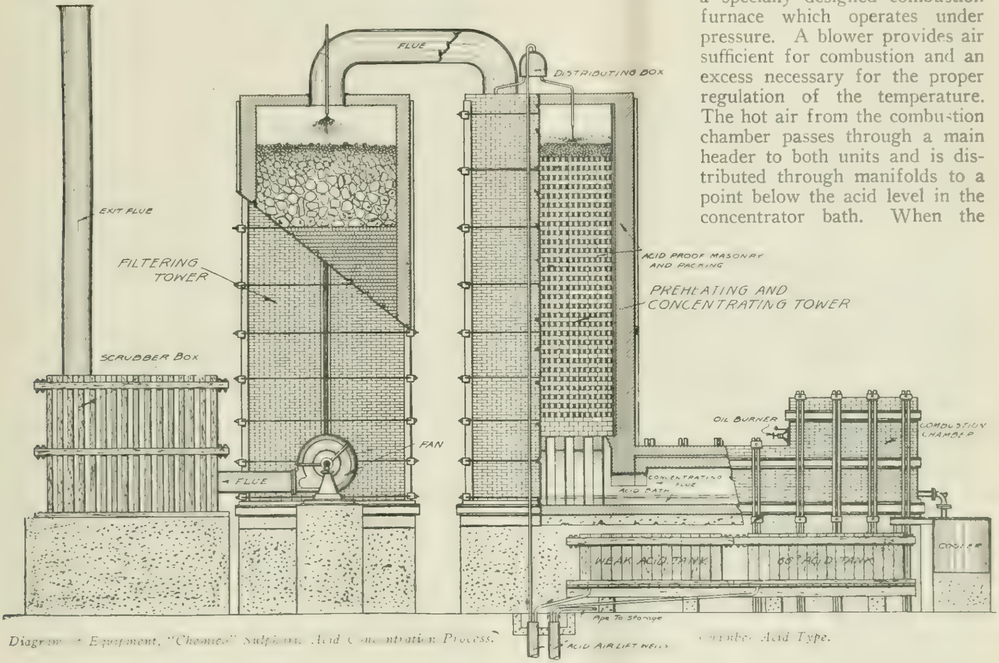


Diagram of Equipment, "Chemico" Sulphuric Acid Concentration Process. Chamber Acid Type.

First Stage Operation

The weak acid is fed in at the top of the tower direct from the pumping lines. The pumping and regulation of the acid are done entirely with the well-known acid air-well lifts. The rate of supply is carefully regulated to control the speed of operation, also the strength and temperature of the acid bath in the concentrator. By controlling the temperature and the quantity of air blown through the acid, and the amount of acid fed to the concentrator, the acid in the pan is maintained constantly at from 50-55° Bé. or just below the point at which foaming commences. At this strength the acid hydrocarbons are broken down and volatilized by the rapid stream of air passing through the acid.

The acid remains constantly at a strength sufficiently low so that carbonaceous matters (tar, oil, etc.) are not attacked, and consequently the losses in the first unit are practically negligible. The acid is drained off continuously, passing through a cooler into intermediate storage tanks from which it is pumped to the top of the high stage unit for the second stage operation. The operation of the high stage unit is very similar to that of the low stage unit. The acid bath is maintained at 66° Bé. and is drawn off continuously at that strength. The finished acid comes out of the concentrator at about 110° below its actual boiling point. Each unit is provided with a tower packed with checkered brick which serves principally as a preheater.

The hot air is produced by the combustion of oil in a specially designed combustion furnace which operates under pressure. A blower provides air sufficient for combustion and an excess necessary for the proper regulation of the temperature. The hot air from the combustion chamber passes through a main header to both units and is distributed through manifolds to a point below the acid level in the concentrator bath. When the air at 1200° F. is released under the surface of the acid, it quickly gives up its heat and passes out of the bath at a temperature slightly higher than the temperature of the acid. It gives up all of its remaining practical heat in passing through the preheating tower.

The two units in which the first and second stage of concentration are carried out are of similar construction. The acid bath is contained in a rectangular lead pan on a raised concrete foundation, the pan being lined with acid-proof brick. About two-thirds of the pan is covered with a chemical brick arch through which the acid-proof iron pipes project that carry the hot air under the surface of the acid. A tower of acid-proof masonry rises from the rear end of the pan to a height of about 30 feet. This tower is packed with staggered brick and provides sufficient heated surface to transmit the heat from the escaping gases to the incoming acid.

The results over a protracted period of operation have shown the oil consumption to be around 35 gallons per ton of 66° acid when starting from acid of 35° Bé. at room temperature, and the oil consumption further includes raising the heat of the acid in the second stage operation. This gives an equivalent of about 9½ to 10 gallons of oil per ton of 66° acid when starting from 60° Bé. In the lead-pan system, besides the expense incurred by frequent repair of the pans, it has been recorded that it requires 90-110 gallons of fuel oil to concentrate one ton of 66° acid when starting from 35°.

One man per shift can operate the largest plant in existence, and the maintenance cost has proven to be around 30 cents per ton of 66° acid. Comparative cost of concentrating sludge acid by the old and new method is as follows:

Cost of Producing 66° Acid from 35° Bé. Sludge Acid Using Lead Pans and C. I. Stills.

Oil, 100 gallons @ 4c	$4.00
Labor	.60
General expenses and repairs	2.50
Losses 20% based on $8 per ton of 60° acid	1.60
Operating cost per ton 66° acid from 35° Bé	$8.70

Cost of Producing 66° Acid from 35° Bé. Sludge Acid Using Hot-Air Submergence Type.

Oil, 35 gallons @ 4c	$1.40
Labor	.20
General expenses and repairs	1.10
Losses 6% based on $8 per ton 60° acid	.48
Royalty	1.00
Operating cost per ton 66° acid from 35° Bé	$4.18

Sulphuric Acid Gas Recovery

Fume trouble always has been an important subject for lawsuits, hence the method of recovering gases is germane to my subject.

In the indirect method of concentration, the escaping gases may be efficiently condensed in water-cooled condensers, but when concentrating by the direct-heat method the escaping gases are of greater volume, for which reason the condensers are impracticable. In general practice, a filtering or scrubbing tower is used. These generally consist of towers or large boxes constructed of lead or acid-proof masonry, packed with suitable tower filling, such as coke, hard coal, quartz or rings. If the filtering area, or the tower filling, is of large enough volume, and if the filling material itself is efficient, water is not required. In cases where the filtering area is small, the gases will be absorbed more efficiently by spraying a little water in at the top of the tower. When using water for filtering, in some cases the strength of the distillate acid varies from 30-40° Bé. When not using water in efficient towers the acid varies in strength from 40-55° Bé.

The electric precipitator is being used exclusively for the precipitation of the acid gases, in conjunction with hot-air submergence type concentrators whether used for concentrating chamber acid, sludge acid or other contaminated acids. It also has been found very effective on other installations. It looks as if this precipitator eventually will replace all other gas-filtering methods, as the construction is very simple, the recovery the most perfect and the cost of operation very little. The acid comes out of the precipitator at from 50-60° strength and the recovery in several instances has been recorded at 99 per cent, while the recovery in filtering towers varies from 60 to 95 per cent.

Acid Proof Masonry

The use of acid proof masonry as a permanent construction material for concentrators has been mentioned several times. The success of this construction for concentrators and for all other kinds of acid absorption and cooling towers is assured. The construction requires careful design, the use of superior and proper grades of material, the best workmanship and the proper curing and treating of the cement, especially in the hot towers for sulphuric acid. The outer walls are constructed of acid-proof shale brick and acid-proof cement, and the inside of tower is lined with several layers of 1 in. chemical tile. Towers thus constructed are very durable and if the work is properly done, and the towers properly treated, very little seepage will take place. All masonry towers should be operated under slight vacuum.

The largest example of acid-proof masonry work in this country is the installation of the nitric acid absorption towers and acid concentrators at the Government nitrate plants at Sheffield and Muscle Shoals, Ala. In both places combined there were 14 large towers, each measuring 32 feet square on the outside and 60 feet high, each tower being divided into four parts and each part packed in its entirety with "Chemico" spiral packing rings. In these installations it required millions of brick and several thousand tons of "Acipruf" cement. During the operating test period of these towers, no leakage whatever developed.

Bleaching Powder

Edward T. Ladd and Eben C. Speiden, Niagara Falls, N. Y., claim an improvement in bleaching powder manufacture which comprises the separate chlorination of screened portions of slacked lime (lime hydrate), which first has been screened to separate unhydrated lime and foreign matter. The second screening effects a separation of the more finely divided from the coarser particles of the hydrated lime. The treatment of the latter portion in the usual manner with chlorine in bleach chambers is claimed to yield a bleaching powder that is heavier and more massive than would be the case if the finer particles of lime hydrate had not been removed. The physical structure of the mass of coarser particles permits a more thorough penetration by the chlorine with more effective chlorination, and a corresponding change in the properties of the finished product.

The separate chlorination of the finer portion of the screened lime hydrate yields a bleaching powder which is lighter and more fluffy than is the case when the finer and coarser portions of the lime hydrate are chlorinated together in the usual manner. The physical character of the product arises from the change in the porosity due to the fineness of the particles, which to a large degree governs the penetration of the lime hydrate by the chlorine.

Each product not only is very different from the other but from the bleaching powder as ordinarily made without the additional screening and separate chlorination; furthermore each of these new products has its special advantages for those uses to which it is adapted.

Number 35 of the "Reprint and Circular Series" of the National Research Council is a revision, embracing nearly 300 additional chemicals, of the compilation of research chemicals prepared by Clarence J. West and issued by the Research Information Service. The marked advance shown by the American chemical industry during the last few years is evidenced by the surprisingly large number of high grade chemicals listed in this publication as now purchasable from American manufacturers. The so-called "heavy chemicals" have been omitted because there are so many recognized manufacturers and dealers from whom they may be secured. For the same reason practically all inorganic salts are omitted. Those interested in this booklet may secure a copy from the Research Information Service, National Research Council, Washington, D. C.

The British Association of Chemists

By S. Reginald Price, M. B. E., M. A.

General Secretary, British Association of Chemists

THE British Association of Chemists owed its inception in the first place to the urgent need experienced during the war for a professional association for the trained chemist, as distinct from the purely scientific and educational organizations then in existence, which by reason of their constitution were, and still are, unable to undertake the protection of the economic and professional interests of chemists.

The Association adopted as its first slogan, the memorable words of John Hancock when signing the Declaration of Independence: "If we don't hang together we shall all assuredly hang separately." This was a fair indication of the spirit underlying the foundation of the Association, but since the war, the broader aspects of the profession have modified our outlook and our policy is best exemplified in the words of the late Lord Moulton: "Take my advice. Unite! Hold high the standard of Chemistry and Chemical Industry, and there will be a brilliant future for you, not only industrially, but in the respect that is paid to your profession by the Nation."

The British Association of Chemists is nominally incorporated under the Trade Union Acts in order to give us that freedom of action which we could not secure under the Companies Acts and which restricts materially those bodies incorporated under Royal Charter. For some years, our proceedings appeared at frequent intervals in the *Chemical Trade Journal* but we have now decided to issue a quarterly Bulletin and the first number is to appear in July next.

Objects

The main and immediate objects of the British Association of Chemists are as follows:

1. To organize the qualified chemists of the country into one powerful body irrespective of their method of qualifying, so that by the strength and prestige of such organization the Association would be in a position to speak for the whole of the profession and to command attention to any proposals it may put forward on behalf of science.
2. To advance the interests of science, pure and applied, as an essential element in the national life and to raise the economic and professional status of all qualified chemists.
3. To improve the conditions of employment of persons having adequate scientific training and to protect and promote by corporate action the economic welfare of the members.
4. To encourage scientific education and research and to ensure that all persons desirous of entering the chemical profession shall receive adequate training.
5. To maintain an efficient Appointments Bureau which shall give all possible help to chemists and inform them of the nature of the positions offered and the character and scope of the work.
6. To protect the chemist from injustice, by affording him such support as shall give him independence of action.
7. To maintain funds for the relief of members when unemployed, sick, victimized or in distress; for the provision of legal and other advice on all professional matters; for the institution and support of legal proceedings where necessary on behalf of the Association or any of its members; or for any other lawful purpose determined by the Council with the consent of the Members.
8. To ensure in the public interest that all scientific and technical departments in the public services and in industry shall, in so far as they involve chemical knowledge, be under the control of properly qualified men.
9. To promote or assist in securing legislation in the interest of chemists and to safeguard their interests in political matters.
10. To maintain and insist on the observance of strict rules of professional conduct.

Organization

The Association consists of a number of geographical sections carrying out the objects of the Association in their several localities and of Guilds for the better consideration of questions affecting specific branches of the chemical industry. The ultimate government is vested in the Council which is elected annually by the Sections in proportion to their membership. The relations of the Association with the various other scientific bodies have been of a cordial and harmonious nature.

Membership Qualifications

Our standard of membership is strictly enforced as we believe that only by such means can the status of the chemical profession be raised to its rightful position. Membership classification embraces Members, Probationers and Students. The qualifications are defined in the constitution as follows:

> The qualifications for Members shall be:
>
> 1. A university degree or its equivalent as approved by the Council, with chemistry as principal subject, and in addition one year's practise in the application or teaching of chemistry.
> 2. A sufficient general education and scientific training and at least seven years' practice in pure or applied chemistry, with evidence of dependability and initiative.
>
> There shall be no sex disqualifications.
>
> An applicant unable, through lack of qualifications, to secure admission as a member may:
>
> 1. If over 19 years of age and earning his living by the application of chemistry, become a Probationer by undertaking to make up the deficiency indicated by the Council within the time specified by them; or
> 2. If under 21 years of age, having passed a matriculation or equivalent examination or otherwise satisfied the Council as to his general education, and having stated his intention of studying to qualify as a member, be admitted as a Student.
>
> A Student shall automatically become a Probationer on obtaining a university degree or its equivalent, as approved by the Council, with chemistry as the principal subject, and with one year's approved practice in the application or teaching of chemistry shall become a member.
>
> A Student attending evening courses at a recognized educational institution, and who, during the day, is engaged in the application of chemistry, and has been so engaged for at least one year, shall automatically become a member on obtaining a university degree, or its equivalent, as approved by the Council, with chemistry as the principal subject.
>
> Probationers and Students shall have no vote.

During the last fiscal year, ending September 30, 1921, 205 new members were elected, 11 resigned, and losses due to death amounted to 3, giving a total membership as of that date of 1,344. With the furtherance of economic proposals before the Council, assurance that the position of the Association will be further strengthened by the acquisition of a large number of chemists who are still outside the ranks of the Association, has been realized.

Activities

The objects of the Association are being carried out in the order of their urgency and the need of the members. The Appointments Bureau has been in existence since the middle of 1920 and has proved of considerable help in securing employment and in keeping members informed of vacancies existing in the profession. The scope of the Bureau is being extended so as to bring the Association into direct touch with employers of chemists and to emphasize to those who do not employ chemists the advantages to be derived by technical supervision and control.

To those members who, unfortunately, are without employment the Association offers material assistance through its Unemployment Benefit Scheme whereby for a period of six months, help is given whilst the member is seeking employment. None of the objections of a personal nature inherent in a Benevolent Fund are met with under this scheme which, further, tends to keep up the status of the profession by increasing the independence of the chemist when an appointment is under consideration.

The Legal Aid Fund, since its quite recent inception, has proved of great value in rendering legal advice on agreement and other professional matters. A large number of members have availed themselves of the fund and have benefitted materially thereby. It is a settled policy of the Association to support its members to the fullest extent in its power in questions and disputes of a legal nature.

The above are the permanent sections already organized and in addition the Association undertakes all other questions of a professional nature as they arise. The work is being continually extended and further economic proposals are under consideration.

Administrative Personnel

The chief executive officers for 1922 comprise: President, Prof. J. W. Hinchley, Wh.Sc., F.I.C.; Vice-President, F. Scholefield, M.Sc., F.I.C.; Hon. Treasurer, H. S. J. Cory, M.Sc., A.I.C.; Hon. Registrar, David Bain, D.Sc.; Hon. Editor, R. Brightman, M.Sc., F.I.C.; Trustees, G. Tate, Ph.D., F.I.C., P. Haas, D.Sc., Ph.D., and F. Scholefield, M.Sc., F.I.C.

The General Council under the chairmanship of William E. Kay comprises representatives of sections covering the regions of Manchester, Liverpool, Leeds and Bradford, Notts and Derby, London, Scotland, Birmingham and the Northeast Coast.

English Conditions

The lack of legal status, co-ordination, and corporate discipline in the chemical profession in Great Britain, can be attributed directly to the following reasons:

First of all, to the widely opposed views held by sections of the profession of what constitutes a chemist. Different standards have been set up by the various chemical organizations throughout the country, and until some consensus of opinion can be arrived at no material progress in regulating the profession will be achieved.

Secondly, the difficulties to be overcome are further increased by the ambiguity of terms and misapprehension existing in the public mind due to the assumption through long usage and statute of the title "chemist" by a large section of the pharmaceutical profession. Much opposition is to be anticipated from the chemist and druggist and proprietors of multiple "cash chemist" establishments to any proposals put forward for securing by force of statute a legal status to the chemical profession.

Further, and this is more regrettable, there is the unaccountable apathy encountered among chemists when efforts are made to organize them for the consideration of this and similar questions. Large numbers of chemists are extremely loth to bestir themselves to attack the vital problems connected with their profession. At a conservative estimate, not more than 20 per cent. of the chemists of the country are members either of the Institute of Chemistry or of the scientific associations of chemists.

The legal re-definition of the term "chemist" and the raising of the status of the profession are among the foremost objects of the British Association of Chemists, and many recent attempts have been made to form a committee from among the various interested organizations for preliminary consideration of the whole position.

I submit that, unless and until these or similar proposals are adopted, chemistry will never rank, with medicine or the law as a profession in the eyes of the British public.

Officers of the Manufacturing Chemists' Association

The Manufacturing Chemists' Association of the United States assembled for its fiftieth annual meeting on June 16 at the Whitehall Club, 17 Battery Place, New York.

The semi-centennial meeting of one of the oldest trade associations in the country was unostentatious and embraced the consideration of committee reports and the transaction of the usual routine business. The report of the executive committee, Henry Howard, chairman, appears on page 281.

The folowing officers for the ensuing year were elected: Dr. Chas. L. Reese, E. I. du Pont de Nemours & Co., president; C. Wilbur Miller, Davison Chemical Co., and Dr. Milton C. Whitaker, U. S. Industrial Alcohol Co., vice-presidents; S. W. Wilder, Merrimac Chemical Co., treasurer; John I. Tierney, secretary.

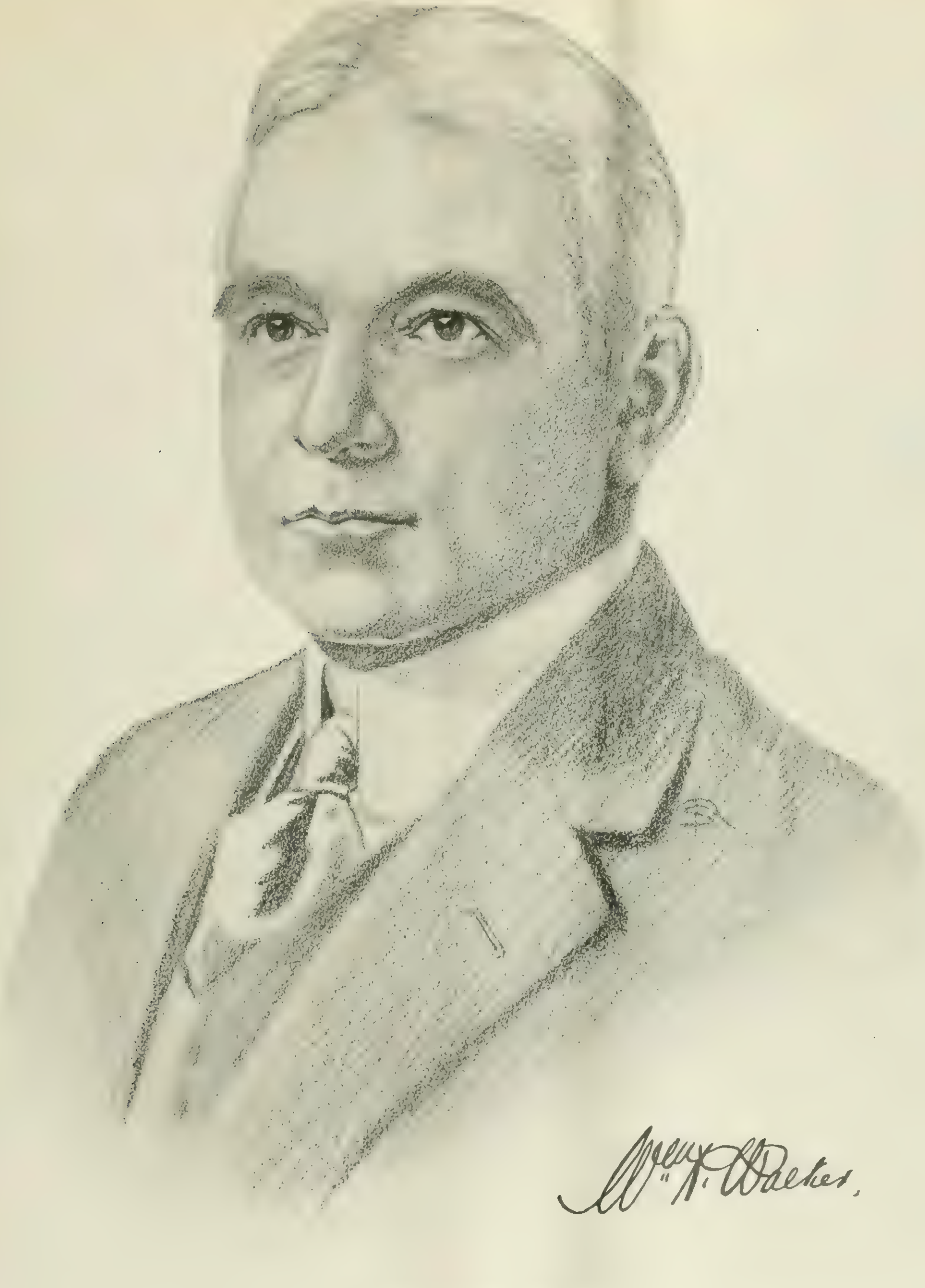
The Executive Committee comprises: Henry Howard, Grasselli Chemical Co., chairman; Lancaster Morgan, General Chemical Co.; A. G. Rosengarten, Powers-Weightman-Rosengarten, Inc.; H. H. Dow, Dow Chemical Co.; Robert T. Baldwin, Nat'l Aniline & Chemical Co.; T. M. Rianhard, The Barret Co., and E. M. Allen, Mathieson Alkali Works, Inc.

International Congress on Liquid Fuels

The Société de Chimie Industrielle of France is organizing an International Congress on Liquid Fuels to be held in Paris in October of the current year. The Société de Chimie Industrielle is the largest French Chemical Society corresponding in France to our American Chemical Society and to the Society of Chemical Industry in England.

This Congress is being organized in accordance with a desire expressed by the Hydrocarbons and Petroleum Section of the International Congress of Chemistry, held in June of last year. The two principal questions to be dealt with in this Congress are the terminology of petroleum products and analytical methods. Other matters also will be dealt with in the sectional meetings which will be held in separate sections under the headings: (1) Petroleum; (2) Oil Shales; (3) Tar and Benzol; (4) Alcohols.

An exposition will also be held in connection with the Congress. It is hoped that American fuel technologists will be adequately represented, considering the extremely important position held by this country in that field. Communications and requests for further information should be addressed to the Secretaire General, M. Jean Gerard, 49 Rue des Mathurins, Paris, France, and may be written in English.



Wm H. Walker.

Dr. William H. Walker

Consulting Chemical Engineer

Formerly Professor of Chemical Engineering and Director of Division of Industrial Cooperation and Research,
Massachusetts Institute of Technology; **Formerly** Lieutenant-Colonel, Chemical Warfare Service,
in Charge of Edgewood Arsenal.

An outstanding figure in the development of chemical engineering education in America, Dr. Walker organized the course in chemical engineering at the Massachusetts Institute of Technology in 1907, laying down for the first time a curriculum along lines now universally accepted as sound; at the same time he established the Research Laboratory of Applied Chemistry, antedating the consummation in 1911 of Dr. Robert Kennedy Duncan's vision of the Mellon Institute of Industrial Research. **His School of Chemical Engineering Practice is the most important development in engineering education since the introducton of the** laboratory method of instruction. When war found the nation without the weapons of chemical warfare, he organized their production so successfully that in **six months our output of mustard gas was four times that of the Germans, who had used it for a year and a half. In "The Technology Plan," Dr. Walker crowned** his career as a teacher of chemistry with the inauguration of a uniquely practical type of cooperation between Industry and the University.

CHEMICAL
AGE

Volume 30
Number 6

June
1922

A Consolidation of
The Chemical Engineer
and Chemical Age

EDITORIAL

THE Manufacturing Chemists' Association of the United States submits itself, in the report of its executive committee on the activities of the 50th year of its existence, as a trade association of the type that wins the commendation of Secretary Hoover. Perusal of this report is with the impression that this trade association looks upon itself as a trustee whose responsibilities pass beyond the interests of its members to those of the people in whose welfare the members' interests are rooted.

The attitude of the Association towards legislation affecting business is one worthy of consideration as regards the chemical industry, particularly as to those chemical products whose unrestricted importation under present conditions of foreign production costs would compel, in the destruction of numerous branches of the domestic industry, dependence upon alien sources of supply.

Inasmuch as chemical industry is the basic industry, its promotion redounds to the benefit of all industry, so we find the Association through its executive members alert to the significance of legislation affecting patent office administration and international patent relations, for patents constitute the corner stone of our economic structure.

The attitude of the Association towards commercial bribery, which is the "tip" in its most insidious form, should impel the concern of every industrialist to promote legislation that will register advancing standards of morality in trade in the condemnation and penalizing of this vicious practice.

Realizing that a great domestic obstacle to increased production and employment is a price level inhibitive to purchasing, in which a large element is war taxes of a volume restrictive of enterprise, the executive committee takes the political [illegible] to the [illegible] of an economic problem and so contributes to its general condemnation.

Outstanding in the report of the work of business chemists, which rises to the level of a public document of general industrial interest, is the necessity of business men, necessarily through trade associations, identifying themselves with the functions of government. Only thereby can we get "more business in government," in the best sense of the phrase, and have assurance that political measures shall reflect economic law.

THAT a chemically trained man, a chemist, a teacher of chemistry, a president of a school of applied science, is distinguished by a seat in the United States Senate should be the subject of exultation by all craftsmen in chemistry. But when this subject of political distinction advocates the flat money heresy in a proposal that the Government issue 2½ billions of paper currency with questionable redemption features to facilitate the cash payment to healthy young men of a blackmail bonus fostered by politicians, over and above the half billion now being spent on the disabled, the thoughtful man everywhere cannot but feel that education in this instance has failed in its purpose to make one think straight.

People look to the educated man for sound guidance. That he is a product of scientific education increases his responsibility in this scientific age. Senator Ladd has demonstrated, along with Henry Ford and Thomas A. Edison, that eminence in one field in no way qualifies a man for infallibility of judgment in unrelated fields, particularly when the conviction flows from sentiment and selfishness, regardless of their consequence.

WE make our own troubles. At a time when under-consumption awaits upon prices that will encourage production and re-enlist the idle, obstacles innumerable still remain in the way of restoration of equilibrium of prices and costs between different branches and classes of industry. Despite wage deflation in many lines, the heavy spread of distribution expense between producer and consumer leaves little advantage to the latter. The complacency with which industry views the coal miners' resistance to war-time wage reduction indicates that production presses but lightly upon the manufacturer. Railroad labor demands, under threat of industrial prostration, that its privileged position shall remain undisturbed despite the decisions of a government agency designed to regulate wages.

Depleted stocks, worn out equipment and housing demands encourage spotted resumption of production, which, in the hesitancy inspired by the uncertainties and inequities of political manoeuvering, leaves much ground to be covered before it can become general. Statecraft, in the scramble for class advantage and personal interest, has fallen to its lowest level in our political history; instead of being a constructive, it has become a demoralizing influence in our industrial and commercial affairs.

IF the engineer utilizes the forces of nature for the benefit of man, the chemist determines the constitution of matter and its behavior under these forces—a mutual dependence so intimate that its appreciation today profoundly is influencing professional education in chemistry. This fact is shown by an inspection on page 243 of the classification of young men who in the current scholastic year are studying the technical professions. Of the total number studying chemistry and chemical engineering, 8 per cent aspire to be chemists and 92 per cent chemical engineers.

The chemist is a tool; he works in miniature. The engineer is an executive; he works in mass. The chemical engineer is the type of chemically trained man desired for executive work in chemical industry. The technical school as the servant of industry seeks to supply this demand.

THE non-coms. and privates in the army of Chemistry, without the aptitude and application required for scientific attainments in the *staff*, go into the various branches of production where recognition awaits capacity either in the *line* of the organization or in such work as native predilection may determine. So we have every class and variety of chemist who as his work is more and more removed from the laboratory is less and less inclined to characterize himself as such. Here we have in play a process that eventually will man chemically controlled industry from bottom to top with chemically trained men.

Of common academic origin, a divergence from community of interest begins with the chemists' initial specialization in industry, which a certain insularity and intolerance, a by-product of their specialized training and working environment, make difficult to check. We have explained that education drives men apart for it contributes to independence in ways of thinking. Helplessness individually to improve a low economic status drives them together under the impulsion of precedent and in the conviction that only by organization can conditions complained of be improved.

This very briefly is the psychology of the movement now generally under way in English-speaking countries to promote the status of the chemist by his definition and alignment in an economic professional organization, as distinguished from the educational society in whose functions appear the *toxins* to which the former organization would seek to become *immune*. In this direction greater progress has been made in Great Britain and Canada than in America.

Under the influence of the demand for proficiency and the prolonged preparation essential thereto, chemistry as a distinctive profession will be the pursuit of a narrowing group. This trend involves no disadvantage to industry, for the pioneering, creative capacity of the exceptional few will provide commensurate opportunities for the many of less ability. We have an example in the work of Dr. Baekeland, as may be noted on page 246.

THE tendency in America with those of assumed influence has been, with ulterior motive, to ridicule the definition of a chemist, when, as a matter of fact, his definition and classification can be made as easily and more justly than those of a lawyer or a doctor. Not passing the bar examination, as with the lawyer, or satisfying the State Board of Medical Examiners, as with the doctor, at a time when knowledge of the principles of the profession are freshest, but character, capacity and experience as developed in industy determine the definition and classification of the chemist. A string of degrees will not make him one if he can't help his organization to make money. It isn't what a man knows; it is his ability to sell it, to let his knowledge be of benefit to others, that puts him across and enables him to fill out to his pretensions.

For reasons arising obviously out of the direction of the chemically trained man's service, the suggestion of a license to practice chemistry is inane, for the chemical graduate on entering industry only has passed within the portals of his training. He deals not, as does the young doctor or lawyer, with an individual who has only himself to blame for the practitioner's incapacity, but enters into the relationship of master and servant; if he can't make good he is fired and with stigmata infinitely greater than inheres in the failure of him who kills a patient or causes a client to lose a suit.

Success, i. e., ability to make money for others and for himself; the performance of meritorious service in the various fields and grades of work for which professional chemical education is essential; not chemical education but what he does with it, is the touchstone of the definition and classification of the chemist.

THUS we see that the chemically trained man's progress is the reflection of his reaction to the environment and how necessary and important it is for both the individual and industry that he be aided in the work of adaptation in ways not taught in books or schools. This is the responsibility of the professional organization. To discourage by duplicity and subterranean antagonism the ambitions of men to do by their kind what is done by alert men in every line of work characterized as professional is the outstanding anomoly of the economic pathology of the chemist.

This perverse attitude, as already explained, is not original to America; it has been met and worsted in Great Britain and Canada. It arises from the motives of chemical politicians who seek to preserve control of educational, segregational enterprise in American chemistry, and who are not big enough to see that such enterprise would be strengthened by divorcing incompatible functions. The American chemist wants a separate, independent and distinctive professional organization; he resents the group domination of the educational society engrossed with the idea of "one big union" and indifferent to the ideas of those who feel that the intellectual ballast of the chemist should be shifted to the direction of cultivation of his material welfare in a professional organization.

The Fixed Nitrogen Research Laboratory

THE resignation of Dr. Richard C. Tolman as director of the Fixed Nitrogen Research Laboratory since 1919 to reenter educational work at the California Institute of Technology in the autumn, and the appointment of Dr. Frederick G. Cottrell to the directorship, warrants a review of origin, growth and functions of this governmental agency in development of the art of nitrogen fixation.

At the outbreak of the World War, the United States found itself seriously unprepared in the matter of nitrogen for explosives. The War Department undertook to remedy the situation as quickly as possible, but found itself greatly handicapped because only a few men in the country were familiar with the nitrogen problem. One of the first steps taken by the War Department was to call into consultation some of the ablest scientists available. Following this a Nitrate Commission was formed, which recommended the building of plants for the fixation of atmospheric nitrogen so that ammonium nitrate could be secured for explosives. Upon cessation of hostilities, the plants were to be utilized for the production of fertilizer materials, as well as nitrogen compounds useful in the arts.

Buildings Occupied by Fixed Nitrogen Research Laboratory, Washington, D. C.

After the armistice was signed, the Fixed Nitrogen Research Laboratory was established by the Secretary of War, in order to coordinate the knowledge which had been obtained concerning nitrogen fixation by the War Department during the war, as well as to obtain the further information which would be necessary for the peace time utilization of the Government nitrate plants at Sheffield and Muscle Shoals. The budget of the new laboratory was paid from funds which were made available to the President of the United States by the National Defense Act of June 3rd, 1916, specifically authorizing him to "cause to be made such investigations as in his judgment are necessary to determine the best, cheapest and most available means for the production of nitrates and other products for munitions of war and useful in the manufacture of fertilizers and other useful products, by water power or any other use." The Laboratory is engaged in carrying out the provisions of that act.

The Laboratory is located at the American University, Washington, D. C., making use of buildings and equipment formerly used by the Research Division of the Chemical Warfare Service, U. S. Army. Owing to the potential seriousness of the nitrogen problem from a national point of view and the number of difficult chemical researches necessary for successfully conducting the work, a specially trained personnel was first necessary, many of the men being selected because of their experience along similar lines in the Research Division, Chemical Warfare Service. The present personnel of the Laboratory numbers 107.

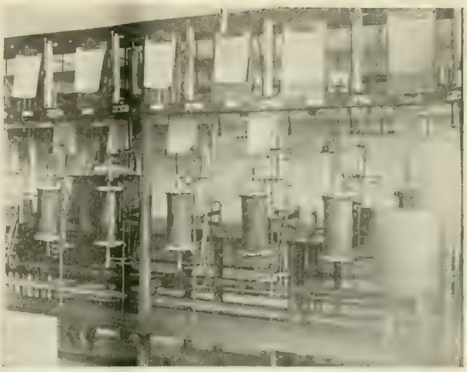
The total equipment and facilities for purposes of chemical research has a value of approximately $1,000,000, most of which was secured from the Chemical Warfare Service and from Army Salvage Boards without cost to the Laboratory. Besides the equipment and supplies of standard design, a large amount of specially designed and constructed apparatus, machines, etc., have been installed at the Laboratory. The main work of the Laboratory has been to study the fixation of nitrogen by the cyanamide, Haber and arc processes, and to study the methods of transforming the various forms of nitrogen-containing products so as to make them most available for military, agricultural and industrial uses.

The work of the Laboratory has been carried out with particular reference to the peace-time utilization of the Muscle Shoals, Ala. (cyanamide) plant, and with reference to the changes that must be made in the small Sheffield, Ala. (Haber) plant in order to make its operation successful. It has obtained a catalyst for the reaction between nitrogen and hydrogen to form ammonia which it is believed equals if not surpasses the catalyst which the Germans had obtained up to the time of the armistice when the Oppau plant was made available for Allied inspection. The catalyst is satisfactory, both from the point of view of stability and from the point of view of the large yield of ammonia which it gives. It is believed, however, that much superior catalysts can be made, and that the theory of catalytic action can be so elucidated with further work as to put the whole art of catalyst manufacture on a firm scientific basis.

For the purpose of catalyst testing there has been developed a high-pressure catalyst-testing plant at a cost of between $90,000 and $100,000, which has now been in successful and continuous operation for about two years, and which is, as far as is known, the only catalyst-testing plant outside of Germany which has ever been operated continuously for more than a few weeks at a time. This plant is operated on a shift basis twenty-four hours per day with a specially trained personnel, and it has only begun to realize on the cost of the investment involved. The testing of catalysts for ammonia synthesis will certainly be an important need of the nitrogen industry in America for many years to come, and the unusual equipment at the Fixed Nitrogen Research Laboratory should certainly be maintained available for testing catalysts whether developed in the future by the Government or by the industries.

For testing catalysts at lower pressures, for studying the theory of catalyst action, and for carrying out other chemical researches incidental to the development of the Haber process, there has been installed special ap-

Bomb Room, Catalyst Testing Plant, Fixed Nitrogen Research Laboratory.



Small Scale Catalyst Testing, Fixed Nitrogen Research Laboratory.

paratus at a cost of about $20,000.

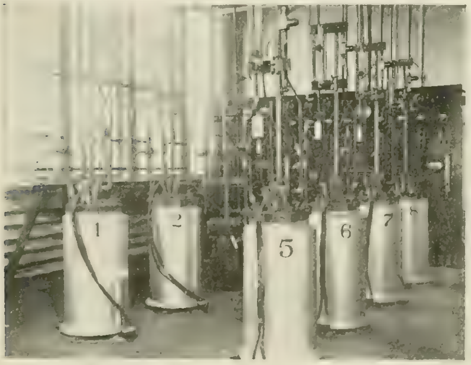
The cyanamide process, which is the one installed at Muscle Shoals, is one of the best known and best established methods of fixing nitrogen, and the laboratory has completed a large amount of work in connection with the peace-time utilization of the Muscle Shoals' plant. The cyanamide process is at the present time the only process by which nitrogen can be fixed on a large scale in America in case of emergency. The laboratory believes that it will remain an important method of fixing nitrogen for many years to come. It is susceptible of considerable improvement and can furnish a great variety of nitrogen products.

The Haber process, which under certain industrial conditions certainly can displace the cyanamide process, has until very recently never been commercially operated outside of Germany. It presents unusual engineering difficulties in that large quantities of flammable gas have to be handled at high pressures and high temperatures.

The Laboratory also has conducted agricultural investigations on the utilization of the new fixed-nitrogen compounds. This has been carried out partly in cooperation with the Bureau of Plant Industry by means of pot and field tests, and partly by experimental work at the two Alabama plants, where twenty acres were given over to agricultural tests. This work is a direct consequence of the very peculiar chemical nature of cyanamide which makes its utilization in agriculture a matter that needs further investigation. Samples of fertilizer material for tests are prepared by the Laboratory. The Laboratory has collected important information as to the behavior of about ten nitrogen-containing substances in these field tests.

As to the arc process, the Laboratory has installed special equipment for this study, having a value of about $14,000. From a military point of view this is one of the most important methods of nitrogen fixation, since it can be most rapidly installed in case of war and since it provides nitrogen at once in the nitrate form without the necessity of any oxidation from the ammonia form. Since the Government owns no arc plants, the Laboratory has for the time being given less attention to this process than to others and has confined itself to studying the fundamental theory of chemical reactions in the path of the electric discharges. Owing to the great difficulty of the problems involved, they have only begun to realize on the time and investment which have been put into this work.

C. R. De Long, head, chemical section, U. S. Tariff Commission, has been appointed chief of the new chemical and dye division of the Bureau of Foreign and Domestic Commerce which will become operative Aug. 1. Mr. De Long, who is an Ohio State University chemist, has been in charge of the dye and chemical statistical work of the Tariff Commission for the past four years.



Ammonia Crackers, Fixed Nitrogen Research Laboratory.

Section of Compressor Room, Catalyst Testing Plant, Fixed Nitrogen Research Laboratory.

Women in Chemistry

A Study of Professional Opportunities

THE most notable current contribution to the literature of chemistry is to be credited to the Bureau of Vocational Information, 2 West 43d St., New York, an organization devoted to the cultivation of professional opportunities for women. While in the book itself appears acknowledgment of the coöperation rendered in the prosecution of the study, the idea of the work was conceived and developed by the staff of the Bureau of which Miss Emma P. Hirth is director and who generously credits her assistant, Miss Beatrice Doerschuk, with the chief responsibility for its successful accomplishment.

In the preparation of this study of chemistry as a career for women, the Bureau had the cooperation of a committee of the American Association of University Women, representing teaching, medical research, and industry. The personnel of the last group comprises:

Miss Emma Crandell; Miss Helen Clark Gillette, Central Research Laboratory, Union Carbide & Carbon Research Laboratories, Inc.; Miss C. M. Hoke, Jewelers' Technical Advice Co.; Miss Kathryn Holden, Nestles Food Co.; Mrs. Glenola Behling Rose, E. I. du Pont de Nemours & Co.; and Miss Elizabeth Weirick, Textile Testing Laboratory, Sears, Roebuck & Co.

This contribution, entitled "Women in Chemistry—A Study of Professional Opportunities," while addressed to the college woman enamoured of a career in chemistry, not only should be in the hands of every student of professional chemistry, but should be read by every teacher and practitioner, for it is the first scientifically compiled, comprehensive survey of the requirements, opportunities and responsibilities of the profession of chemistry in America.

Part I is devoted to a discussion of chemistry as a vocation. Part II comprises an analysis of positions in chemistry in educational institutions covering kinds of work and kinds of schools; in laboratories for medical and related analysis and research covering kinds of work and kinds of laboratories; in laboratories for industrial analysis, development and research covering kinds of work and kinds of laboratories; in federal, state and municipal laboratories; and in the related fields of pharmacy, microscopy, assaying, metallurgy, bacteriology, plant physiology and dietetics.

Part III is devoted to the requirements of professional work in chemistry in undergraduate and graduate training, with considerations pertaining to special fields of work. Part IV covers further vocational considerations under the captions: Numerical Importance of the Vocation; Advantages and Limitations of Chemistry as a Career; Qualifications Required; Salaries; and Means of Securing Positions.

In the appendix are given (1) a list of colleges and universities in which women may secure graduate training in chemistry, (2) prizes and grants available for research in chemistry, (3) fellowships and graduate scholarships open to women, (4) scientific, technical and other periodical publications of interest to chemists and (5) scientific societies for chemists.

Salaries

The wage data presented in the course of the investigation are in part reproduced, together with a brief discussion of the requisite preparation for professional chemical work and of the approximate number of men and women engaged therein.

Rates of compensation for scientific work compare with professional rather than with commercial salaries and do not offer the primary compensation for this type of work. In teaching, salaries have been notoriously low, but have in the last few years been increased very generally and to a marked extent. Hospitals are able to pay only small salaries; medical research has been compensated usually at university rates. Industry has paid the largest salaries, but only in a comparatively small proportion of cases. The large number of routine chemical workers are paid at approximately the same rates as are clerical workers.

Salaries in State Universities and Colleges

The Bureau of Education has reported the following figures to indicate what increases in salaries of the faculties of state universities and colleges have taken place between the year 1915-1916 and the collegiate year of 1921-1922:

	Average Salary 1915-16	Average Salary 1921-22	Per Cent of Increase
Dean	$3,062	$4,250	38.8
Professor	2,400	3,392	41.3
Associate Professor	1,926	2,800	45.4
Assistant Professor	1,603	2,300	43.5
Instructor	1,184	1,800	52.0

The highest salary discovered as paid to a woman trained in chemistry and employed in an educational institution is $7,000, which is received by the head of a university department of home economics. Three other teachers' salaries reported were above $3,000; a woman full professor receives $5,000; one associate professor $4,500, a second, $4,000. The following table includes the salaries submitted by 50 women teachers of chemistry in colleges and universities.

Salaries of 50 Women Teachers in Colleges and Universities

	Ass't.	Inst.	Ass't. Prof.	Assoc. Prof.	Prof.	Total
Under $1,000 ...	2					2
$1,001-$1,200	2	3				5
$1,201-$1,500	2	5	3	1	1	12
$1,501-$1,800	1	2	2	3		8
$1,801-$2,000		3	3			6
$2,001-$2,500			6	1	1	8
$2,501,$3,000		1		2	2	5
Above $3,000 ...				2	2	4
	7	14	14	9	6	50

Salaries in Medical Laboratories

In laboratories for medical and related analysis and research the high salaries seldom exceed $5,000. The following table indicates the salaries of 39 women chemists working in this group of laboratories.

Salaries of 39 Women Chemists in Laboratories for Medical and Related Analysis and Research

	Technician	Chemist	Clinical Pathologist	Research Chemist	Total
Under $1,000 ..	5	3			8
$1,001-$1,200	7	3	1	1	12
$1,201-$1,500	2		1	3	6
$1,501-$1,800	1	1	1	3	6
$1,801-$2,000			2	1	3
$2,001-$2,500		3			3
$2,501-$3,000				1	1
Above $3,000					
	15	10	5	9	39

Industry

A chemist of wide experience in industry would put $1,200 as the lower limit for a competent analyst,

$1,500 as the very least that anyone entitled to be called a research chemist should receive, and $2,500 as the minimum for a chief chemist. The scale of salaries in his own laboratories runs far ahead of the figures given.

The yearly rates that prevail in one large and important chemical industry are approximately as follows:

Assistant	$1,380, $1,500, $2,000
Analyst	$2,500
Chemist	$2,500, $3,000
Research Chemist	$3,000, $5,000 high, $10,000 extraordinary
Head of a Division	$4,000, $7,500 (for overseeing one whole plant)
Chief Chemist	$10,000 $12,000

Ninety-seven women chemists in industry have reported their salaries as follows:

Salaries of 97 Women Chemists in Industry

	Analyst	Chemist	Research Chemist	Head of a Division	Chief Chemist	Total
Under $1,000 ...	5		1			6
$1,001-$1,200	11		1			12
$1,201-$1,500	22	4	1		1	28
$1,501-$1,800	11	4	7	4		26
$1,801-$2,000	6		4	4	2	16
$2,001-$2,500	1		2	2	2	7
$2.501-$3,000	1					1
Above $3,000 ...				1		1
	57	8	16	11	5	97

Government Laboratories

The salaries of 21 women chemists in Government laboratories, federal and state, which were reported for this study are:

Salaries of 21 Women Chemists in Government Laboratories

	Analytical Chemist	Research Chemist	Director of a Bureau	Library Research	Total
Under $1,000 ..	1				1
$1,001-$1,200 ...	4				4
$1,201-$1,500 ...	4				4
$1,501,$1,800 ...	5	1			6
$1,801-$2,000 ...					
$2,000-$2,500 ...	4		1	1	6
$2.501-$3,000 ...					
Over $3,000 ...					
	18	1	1	1	21

A study of the economic status of chemists in the Government service in Washington, ten educational institutions, and thirty-seven industrial firms made for the Commission on Reclassification of Salaries in 1919 brought out the following comparison:

Average Salaries of Chemists in the Government Service, (Washington) 10 Educational Institutions and 37 Firms

	Chemists in Washington	Chemists in 10 Educational Institutions	Chemists in 10 Educational Institutions and 37 Firms
Junior Aid	$1,164	$ 720	$1,254
Senior Aid	1,192	900	1.589
Junior Chemist .	1,419	1,908	2,062
Assistant Chemist	1,738	2,878	3,334
Associate Chemist	2,264	2,991	3.888
Chemist	3,042	4,976	6.758
Senior Chemist .	3,904	5,650	10,138

The salaries recommended by the Congressional Joint Commission for Reclassification of Salaries for work in chemistry were:

Junior Aid in Chemistry	.$ 840 - 900 - 960 - 1,020 - 1,080 - 1,140 - 1,200
Senior Aid in Chemistry	.$1,200 - 1,320 - 1,440 - 1,560 - 1,680 - 1,800
Junior Chemist	...$1.800 - 1,920 - 2.040 - 2,160
Assistant Chemist	...$2,400 - 2.520 - 2,640 - 2,760 - 2.880 - 3.000
Associate Chemist	...$3,240 - 3,360 - 3,480 - 3,600 - 3,720 - 3,840
Senior Chemist	...$4,140 - 4,320 - 4,500 - 4,680 - 4,860 - 5,040

The Lehlbach Bill, H. R. 8928, which has been passed by the House of Representatives and is now under consideration by the Senate, provides for the division of the professional service of the Government into groups in which the rates of compensation shall be as follows:

Grade 1	..$1,620, 1,740, 1,860, 1,980	
Grade 2	..$2,100, 2,280, 2,460, 2,640	
Grade 3	..$2,820, 3,060, 3,300, 3,540	
Grade 4	..$3,720, 4,020, 4,320, 4,620	
Grade 5	..$4,860, 5,160, 5,460	A higher rate may be authorized by law.
Grade 6	..$5,400, 6,000, 6,600	

Women Chemists—The Professional Chemical Population

The extent of chemistry as a vocation is approximately indicated by various statistics. The census of 1910 reported 16,126 chemists, assayers and metallurgists; in 1920 this number had increased to 32,941. It is impossible to determine from census reports the proportion of trained chemists in this group; the enrollment of scientific societies is suggestive of what this number may be. The National Research Council has listed 2,172 research chemists. The American Society of Biological Chemists, to membership in which anyone is eligible who has conducted and published a meritorious original investigation in biological chemistry, had 216 members in 1920. American Men of Science records about 1,770 chemists. The American Chemical Society had in 1921 about 14,000 members.

During the war this society had enrolled from 17,000 to 18,000 names of persons eligible for chemical service.

The Proportion of Women

Dr. C. L. Parsons suggests a rough estimate of some 22,000 chemists in the United States. Of this number the proportion of women probably approximates 4 to 5 per cent. Of the 16,126 chemists, assayers and metallurgists reported in the census of 1910, 579 or 3.5 per cent were women. The census of 1920 records 32,941 chemists, assayers and metallurgists of whom 1,714 or 5.2 per cent are women. Of 2,172 research chemists listed by the National Research Council, 70 or 3.2 per cent are women; of 216 members of the American Society of Biological chemists, 7, or 3.2 per cent are women. Among the 1,770 chemists included in American Men of Science, nearly 3 per cent are women. Of the membership of the American Chemical Society about 3 per cent are women.

In 1920 there were conferred in American Universities 96 doctorates in chemistry. Of these, 9, or 9.3 per cent, were conferred upon women. In 1921, of the 134 doctorates in chemistry, 13 were conferred upon women; this was 9.7 per cent of the whole number. It is encouraging to note that of the women entering this profession so large a proportion is securing the superior preparation which is proving to be essential for any progress.

In the preparation of "Women in Chemistry" specific information was received concerning some 660 women chemists. If from a basis of 17,000 to 18,000 enrolled chemists it is safe to estimate some 22,000 chemists in the United States, the enrollment of 660 may justify the estimate of about a thousand women chemists, or from 4 to 5 per cent of the total.

Although their number is small, women are not newcomers in the field of chemistry. It was a book by an American woman, "Conversations on Chemistry," written in 1813 by Mrs. J. Marcet, of New Haven, which contributed to the great Faraday's first interest in chemistry, according to his own statement, when as an apprentice bookbinder he snatched moments from his work to read the books which came to be bound in his employer's shop.

Rachel L. Bodley, professor of chemistry at the Woman's Medical College of Pennsylvania, was chosen as a vice-president of the centennial anniversary meeting of American chemists in 1874. Nor have the achievements of the few women in chemistry been small. Mme. Curie is internationally known and reverenced as one of the greatest living chemists.

In America it is recognized that some of the most important contributions to biochemistry, especially to the chemistry of nutrition, have been made by women —Dr. Mary Swartz Rose at Teachers College, Dr. Icie Gertrude Macy at the University of California, Dr. Alice Rohde Davis and others. Dr. Amy L. Daniels is research professor in nutrition in the Child Welfare Research Station at the University of Iowa, which was organized primarily for investigation in the field of child betterment. Dr. Willey Denis is teaching biochemistry in the Medical School at Tulane University.

Women have proven their ability as teachers of chemistry. Dr. Ellen Terry, assistant professor at the University of Chicago, has collaborated in the preparation of a recent textbook in general chemistry. In the two eastern women's colleges in which the chemistry department is administered by women, Dr. Marie Reimer at Barnard, Dr. Emma Carr at Mt. Holyoke, the work of the department ranks exceptionally high as is evidenced by the quality of the training and the interest of the students. Ten Mt. Holyoke graduates and five from Barnard have taken the doctorate in chemistry. At Mills College, where Dr. Vernette Gibbons is head of the chemistry department, excellent standards prevail.

In industry women have shown their capability for accurate, reliable analytical work and in a few notable instances have contributed to industrial development and research. Dr. Mary Pennington is a recognized expert in refrigeration, Dr. Jessie Minor in paper manufacture; Dr. Nora Neun is issistant superintendent in the manufacture of chemical products. Dr. Dorothy Hahn has contributed to research in dye manufacture while pursuing her work as associate professor at Mt. Holyoke College. Dr. Ruth O'Brien at Iowa State College is a recognized textile chemist whose improvements on textile machinery have been patented.

During the war Dr. Mary Rising worked out with Dr. Stieglitz at the University of Chicago a method for producing luminal, a drug which had been imported, and whose lack caused a great deal of suffering. She attempted to make it according to the process described in the patent and found that only minute quantities could be procured in that way, as was the usual result, since patents are so written as to give a minimum of evidence. The process was improved to such a point that it was taken over, with some minor modifications, for large scale work in the manufacture of the product. Dr. Stieglitz has stated that "Miss Rising's share in the work was essentially in the laboratory in which she worked very efficiently and very skillfully. There is no doubt that the keenness of her observation and close study of laboratory details were a very vital element in the development of the method."

Graduate Training

For progress in work in chemistry it is generally necessary to plan for graduate study. This is increasingly true because of the extensive development of the science in modern times and because the period of economic depression has brought a new evaluation of the chemist and a discrimination strongly in favor of the best-trained workers available. It is generally agreed that while there is danger of an over-production of so-called chemists, there will never be too many *good chemists*. The most promising candidates for the Ph.D. degree are profoundly impressed with the extensiveness of the field and their own small equipment for it.

For two reasons it is evident that superior preparation is requisite for successful work in chemistry. In the first place, the progress of chemistry has been so extensive that an undergraduate course can no longer satisfactorily prepare the student for important scientific service. Not only do the universities emphasize this, but industries have recognized it as well in establishing fellowships for graduate study.

In the second place, chemistry as a vocation represents a comparatively small professional group in which the increase in numbers has been steady but moderate. There is reason to expect a more rapid growth than in the past with the return of industry to full production and with the development of medical research. An unusual number of college students are majoring in chemistry, however, and there are chemists now unemployed. There is, therefore, every reason to expect a stronger competition than ever before, in which the *best* qualifications will win; for science is one field in which there is always a check for all work done and successful competition is based solely on ability and honest results.

In short, the present is a good time for those women who will consider chemistry *seriously* as a career although tradition and prejudice against them are still to be reckoned with, especially in industry. The ability of women has been demonstrated. The air has been cleared in the period of economic depression; it is ability which will count in the future as better efficiency in industry is demanded. The period of preparation for a sound understanding of the science is necessarily a long one and only a true interest in the work itself carries the real chemist through to achievement.

Conclusion

In its 267 pages, 6 x 9, with index, paper bound, "Women in Chemistry" is a timely contribution in this "inventory-taking" period of American chemistry. It is a first-class document for the encouragement of chemical engineering education.

While the perusal of "Women in Chemistry" will not be with the conclusion that the laboratory apron ever will displace overalls, the reader familiar with the field of chemical industry and with his share of experience in the hack work of chemistry, cannot but be impressed with the fact that there is a place for women in chemistry and that they will not be backward in filling it and overflowing into work once considered a masculine prerogative.

Dr. Chas. L. Parsons, vice-president in America of the International Union of Pure and Applied Chemistry, will address this organization at its Lyons, France, conference, June 27-July 2 on "The Application of Chemical Research in Industry in America."

Domestic Potash, Muscle Shoals and Henry Ford

By Dr. Charles H. MacDowell
President, Armour Fertilizer Works

THE fertilizer industry in peace times is the largest user of nitrogen. It can buy nitrogen in the form of nitrate of soda or sulphate of ammonia at less than it costs to make it synthetically. There are ample supplies of such materials available for some years to come. It is therefore not surprising that the interest of the industry in the synthetic production of nitrogen is largely academic. The art is in a state of development. It likely will be more fully standardized and cheapened as to plant and production costs within a few years.*

It has for many years been the policy of the National Fertilizer Association to oppose the imposition of duties on the importation of raw materials entering into the manufacture of fertilizers. In carrying out this policy the Association has opposed the imposition of a duty on sulphate of ammonia, nitrogenous materials and potash salts. In the case of sulphate of ammonia, there is a substantial over-production in this country, as evidenced by the exportation of 157,000 tons of sulphate for the year ending May 1st, 1922, with the importation of only 6,000 tons, this coming mostly from Canada; and this was a year of subnormal production. It is evident that little revenue would be derived from a duty on sulphate of ammonia. The protection asked for would only result in giving American producers the opportunity to ask higher prices from the fertilizer manufacturer and the farmer, without adding materially to Treasury receipts.

A proposed Senate amendment to the Tariff Bill requesting a duty on nitrogenous materials has evidently been inspired by the producers of leather, felt and other wastes which are convertible into fertilizer raw materials. Any great enhancement of the American value for this class of materials would prevent their use in fertilizer, and the rate of duty suggested would absolutely keep out foreign materials, so that no revenue would accrue by the imposition of a duty.

Domestic Potash

The most controversial part of the tariff discussion is the proposed duty on the importation of potash salts for fertilizer use. Every red-blooded American would like to see a potash industry developed in this country, provided it could be done along sound and permanent lines. Unfortunately most of the possible producing centers are situated far from the potash-consuming sections. Freight rates are excessive as compared with those in effect from France and Germany. The bulk of the American product would of necessity be concentrated salts, whereas a large proportion of the potash used in mixed goods is in the form of mine-run, 16 to 20 per cent salts, which cost at ports from 15 to 18 cents per unit less than the concentrated muriate.

The use of those mine-run salts also permits of a better distribution of potash in the fertilizer mixture, and saves dilution expense. It does not seem possible that the American producer can supply this cheaper form of low grade salts in the territory where it is consumed. Aside from revenue reasons there seems to be little justification for the imposition of a heavy duty on potash salts, and it would cost the farmer a pretty penny if the proposed duty were imposed. In inviting Congressional attention to these facts the Association is cooperating with the American Farm Bureau Federation and the National Grange.

There is also another important factor which is of interest to the farmer, as well as to the public generally, and that is, that we have got to buy something from Europe if Europe is to buy our cotton, surplus wheat, copper and other raw materials. If we shut off the importation of potash, to that extent we reduce foreign ability to buy. We throw our badly balanced shipping situation even more out of gear, because we reduce the tonnage of bulk materials west bound. This tends further to increase export ocean rates.

Muscle Shoals and Henry Ford

The disposition of the Muscle Shoals' water power and nitrogen fixation plants continues to engross the attention of Congress. Three plans have been suggested. One is the completion of the dam by the United States Government and the public sale of the power produced. This plan is of great merit.

Another is the consideration of an offer by the Alabama Power Company for the completion of the two dams and the hydro-electric equipment at its own expense. The offer, among other things, provides for the supply of power free of charge for the operation of a nitrogen fixation plant. The offer appears to be based on sound business principles, and would seem to merit serious Congressional attention. It appears, however, to have been overlooked.

Henry Ford has also proposed a plan for the disposal of this Government property. Briefly, Mr. Ford is asking the Government to loan forty to fifty million dollars for one hundred years, at a low rate of interest, in order that he may buy from the Government for five million dollars property worth sixteen million, to make forty thousand tons of nitrogen, in a form now overprduced and largely exported. The propaganda in favor of the Ford proposal has been excellently planned and skillfully executed. Unlimited free press advertising has been given the leading contender for the property. Current topic classes have been brought up to date on the importance of nitrogen and fertilizer. Agricultural societies, chambers of commerce, river improvement associations, boards of trade and other get-togethers have resoluted strongly in favor of the acceptance of Mr. Ford's offer.

It is safe to assume that the representatives of most of these activities knew little or nothing of the merits of the proposal they had been induced to support. Secret processes, weird chemical prophecies, near something for nothing except the freight, and freight cut into quarters by wonderful new concentrations of plant food, as if concentrated fertilizer material were a new discovery made practical only through the immediate development of Muscle Shoals' water power for Mr. Ford—such suggestions have fired public imagination.

It is of interest to note that the present form of Mr. Ford's proposal provides for control of the price and distribution of fertilizer manufactured at Muscle Shoals by a board composed mainly of representatives of farmers' associations working with representatives of the new fertilizer company. The power of the board, which in its discretion can "make reasonable regulation for the sale of all or a portion of such products by the company to farmers, their agencies or organizations," seems to set aside certain provisions of the Clayton Act and the Federal Trades Commission Act. Price discrimination, sales discrimination and unfair competition, when authorized by this board for the products of this plant, appear to be no longer unlawful. What recourse then remains to a private company if damaged by discrimination or unfair competition induced by desire to further special interest or political ambition?

---

*From presidential address of Dr MacDowell at 29th annual convention, National Fertilizer Association, June 14, 1922.

Ford Fertilizer Proposal from a Practical Viewpoint

Mr. Ford's fixed nitrogen would cost him much more than it costs the coke-maker who supplies the fertilizer manufacturer. The coke man could undersell Mr. Ford's costs and place the fertilizer maker on a competitive basis with him and still obtain substantial credits on his coking operations. Mr. Ford would not need to have the Government build him an expensive power plant at Muscle Shoals to enable him to obtain his nitrogen needs at as low a cost as he can make it if he desires to go into the fertilizer business. The coke-maker with his surplus and Chile with its nitrate supply easily can take care of Mr. Ford's prospective needs and save the Government this expenditure, only a small part of which goes into fertilizer manufacture.

There is a probability that a concentrated phosphoric acid can be made with cheap power at Muscle Shoals at less than it could be made there by the sulphuric acid method. This is not true, however, in Florida. Would it be good business for the Government to invest this large sum to enable Mr. Ford to use a small part of the power development in the making of concentrated phosphoric acid, which has been made for twenty-odd years and which has never found a ready sale in volume—and this in the face of an excess production of acid phosphate from Tennessee copper fume and manufactured sulphuric acid in that immediate territory?

Muscle Shoals is not near a heavy fertilizer consuming region. Its product, if distributed in a large way as complete fertilizer, would have to be shipped a long distance from home to find an ample market. Potash would have to be brought from port to Muscle Shoals and back to South Carolina. Before the product got very far it would run into the cheaper-mined Florida rock product with coast-cost sulphur. If the tonnage of mixed goods suggested, i. e., one and a half million to two million tons were made at the Shoals, it would require from 75,000 to 100,000 freight cars to haul it. The shipping season would not extend over 100 days, on an average daily loading of 750 to 1,000 twenty-ton cars. The farmer wants his fertilizer when he wants it. He demands service. He wants different analysis goods for different crops. One model doesn't go with him. The steady supply of empties for the moving of such a tonnage would be almost impossible to secure in that territory, even if modified somewhat by river shipment and storage reshipment. Based on the experience of the trade, the day of the big plant is passing. Smaller plants at the heavy consuming centers with a cheap out freight seems better to serve the customers.

Du Pont Securities on the New York Stock Exchange

The listing of the securities of E. I. du Pont de Nemours & Co. on the New York Stock Exchange is indicative not only of the trend of greater public participation in the affairs of large corporations, but of the growing popular understanding of the significance and place of chemical industry in our economic system. Stockholders have increased in number in the past five years. There have been issued $[illegible] 6% non-cumulative debenture stock and $[illegible] common stock, with $100 par, in addition to $35,000,000 7½% bonds due in 1931. The bonds were issued last year and proceeds used to purchase a large block of stock of General Motors Corp. stock, practically all common.

Due to the 1921 depression, net sales during that year totaled $55,285,181 against $93,983,292 in 1920 and $105,437,932 in 1919. Balance available for dividends in 1921 after inventory depreciation was $4,561,434 against $15,058,022 in 1920. Improvement in general business conditions is reflected in better earnings this year. The consolidated balance sheet shows that at the close of 1921 working capital was $55,630,390 compared with $23,697,717 in 1920. As of March 31 last cash on hand was slightly in excess of $18,000,000.

Growth of the Organization

From its founding in 1802 until 1903 the du Pont organization had been conducted as a partnership manufacturing chiefly explosives and allied products. A group of the younger generation of du Ponts then took over the business and organized a corporation with an authorized capital of $50,000,000. The new company entered the chemical field on a large scale, including the manufacture of cellulose products, leather substitutes, pyralin, artificial silk, acids, paints and other commercial articles.

Demands made by the allies during the war necessitated a financial reorganization to take care of larger volume of business. The parent company as now constituted was organized in 1915 with authorized capital of $240,000,000. The only important additional financing since then was the issue of $35,000,000 7½% bonds sold to take care of purchase of General Motors stock.

The parent company owns the entire outstanding stock of Du Pont American Industries, Inc. This company holds practically all the eneral Motors stock. The holdings of the motor company common stock through subsidiaries at the close of 1921 totaled 7,628,137 shares or 36.95% of total outstanding. In figuring working capital at $55,630,390 at the close of 1921 the holdings of motor stock are not used as a quick asset. The 2,504,000 shares of common stock acquired in 1920 were purchased at a price which netted W. C. Durant slightly less than $11 a share.

Varied Activities

The following compilation giving the holdings in principal subsidiaries shows varied activities:

Company.	% Outstanding Stock Owned.*
E. I. du Pont de Nemours of Penn.	100
E. I. du Pont de Nemours Export Co.	100
Rokeby Realty Co.	100
Du Pont American Industries	100
General Motors Corp.	36
Associated Securities of Can., Ltd.	100
Du Pont Fibre Silk Co.	60
Du Pont Nitrate Co.	100
Du Pont Building Corp.	100
Du Pont-Nobel Co.	51
Hotel du Pont Co.	100
Flint Varnish & Color Works	98.03
E. I. du Pont de Nemours Powder Co.	76.33
Du Pont Chemical Co.	17.80
[illegible]	100
Canadian Explosives, Ltd.	87
Du Pont Engineering Co.	100

*[illegible]

The common stock just listed has an enviable dividend record. Last year's payment of 8% cash was the lowest since inception of the present company. In 1920 18% was paid of which 10½% was cash, 7½% in stock. The dividend record since 1915 shows 30% cash in 1915; 100% in 1916 part in Allied war bonds; 51% with cash and stock in 1917; 26% cash and stock in 1918; 18% cash in 1919; 18% cash and stock in 1920; and 8% cash in 1921. This record is even better than it appears, as the stock has always sold considerably above par and consequently the percentage in stock has been worth more than the percentage in cash.

Hydrochloric Acid by the Direct Union of Hydrogen and Chlorine

By Hugh Kelsey Moore

Director of Research, Brown Co.

OUR process of hydrochloric acid manufacture is so simple that I would not have considered a description of it as the subject of a paper were there not a general misconception as to the extent to which this process is covered by patent rights. The manufacture of chlorine from hydrochloric acid is today of historic interest. The reverse of this process, viz., making hydrochloric acid from chlorine, is typical of the intensive development in chemical industry and a portent of the latter's influence upon the economic complexion of the world. Since Priestly first collected gaseous hydrochloric mercury in 1772, efforts to dissociate the sodium and chlorine of common salt and to utilize these ingredients in commercial forms have been unremitting. The narrative, constituting as it does a history of an important branch of heavy chemical manufacture, is coterminous with modern industrial history to which progress in this field has contributed much.*

HUGH KELSEY MOORE

Director of Research, Brown Co.

The relative amounts of hydrogen and chlorine are easily obtained, for these gases in every installation (without exception, I believe) are obtained from the electrolysis of a solution of either sodium chloride or potassium chloride and the end products for such electrolyses are molecules of either sodium hydrate or potassium hydrate, one molecule of hydrogen and one molecule of chlorine.

$$2NaCl+2H_2O = 2NaOH+H_2+Cl_2$$

The regulation of the relative amounts is accomplished by the relation of the number of cells whose cathode compartments, producing hydrogen, are connected together to the number of cells whose anode compartments, producing chlorine, are connected together. Inasmuch as these cells are usually connected in series it will readily be seen that the relative amounts of hydrogen and chlorine do not alter with the alterations of current going through the cells.

The capacity is dependent on the number of cells connected on the anode side into this circuit, the amperes per cell, the efficiency of the cells, bearing in mind that there must always be at least enough hydrogen to unite with all the chlorine. The capacity will vary with the current passing through the cells.

The industrial manufacture of caustic soda, chlorine and hydrogen is a direct result of the invention of the direct current dynamo whereby the mechanical energy of our waterfalls could be transformed into electric power at a low cost. So long as electro-decomposition was dependent on the current produced by batteries, there could be no progress, as the cost was prohibitive. With the dynamo in commercial use an impetus was given to the perfection of cells for the electrolytic decomposition of salt brine. With the improvements in the last mentioned process the production of chlorine and hydrogen was so cheapened that it was found possible to produce the hydrochloric acid in an electrolytic plant cheaper than the acid could be bought delivered at the works. The large amount of water contained in muriatic acid, being approximately three and one-half times the weight of the dry gas, made freight rates for the acid itself high. The necessity of shipping in glass carboys and the freight on these both ways, also the breakage and interest on the large amount of investment in these containers, militated against shipping this product any considerable distance. The union of hydrogen and chlorine produces a chemically pure hydrochloric acid; this fact alone stimulated the production along these lines.

The Apparatus

Having now briefly touched on the underlying economic factors leading to the production of hydrochloric acid from chlorine instead of the production of chlorine from hydrochloric acid, I will describe briefly by reference to a diagrammatic sketch how we produce hydrochloric acid at the Brown Company at Berlin, New Hampshire.

Referring to the diagram, (1) are electrolytic cells producing both hydrogen and chlorine. The hydrogen from these cells passes through a pipe (2) to a safety seal (3) and from thence through a pipe (4) to the quartz pipe (7). In pipe (4) there is a water pressure gauge (5) and a cock (6). The chlorine which leaves the cells (1) only from a less number of cells than the hydrogen leaves from, enters tile pipe (8) containing a water pressure gauge (9) entering a quartz T pipe (10) surrounding quartz hydrogen pipe (7) entering the furnace (11).

This furnace consists of an iron shell (11) lined inside with fire brick (12). The brick is laid up in china clay. The tops of the bricks are also covered with china clay. The quartz tubes (7) and (10) need not be flush with each other where they enter the furnace as this is unimportant. Near the end of the furnace is a small opening stopped ordinarily by an earthenware plug (14). It is in this furnace that the combustion takes place which will be later explained.

The gases emerge from the combustion chamber (15) through a quartz pipe (16) which by means of S-bends (17) forms an atmospheric cooler, cooled by a water spray from pipe (18). The S-bends (17) are connected with an earthenware spiral coil (19) immersed in water held in tank (20). Coil (19) is connected by pipe (21) to a set of tourills (22) immersed in water held in tank (23) and the gases not absorbed by them enter pipe (24) and then pipe (25) to the bottom of tower (26) filled with broken carbon and coke (27). The top of this tower is connected by pipe (28) to an exhauster (29) with a porcelain rotor. Water enters the tower through pipe (30). The water entering the tower after running through the coke runs out of pipe (25) to a stoneware tank (31). This acid, about 17 per cent, is usually strong enough for our purposes. If, however, stronger acid is needed we open cock (32) in pipe (33) allowing a certain amount of acid to pass through the cooled Tourills (22). This acid may be collected in tank (34). This is in brief the description of the apparatus for making hydrochloric acid from the direct union of hydrogen and chlorine.

---

* From paper presented at Niagara Falls meeting, June 19-22, 1922, American Institute of Chemical Engineers.

The Procedure

Having explained the diagram, I will now describe the process of manufacture. First, the exhauster is started, thereby creating a slight vacuum on the whole system. The water is then turned onto the cooling apparatus; plug 14 is removed and a piece of waste impregnated with oil is inserted. This is then lighted, after which the hydrogen is turned on by opening cock (6). When the furnace is good and hot the plug (14) is inserted and the chlorine is drawn in. The water is turned into the absorption system and the process is running. The safety seal (3) is made of very light tin and blows off when there is an explosion, thereby relieving the pressure on the entire system so that it is not demolished, should there be an explosion.

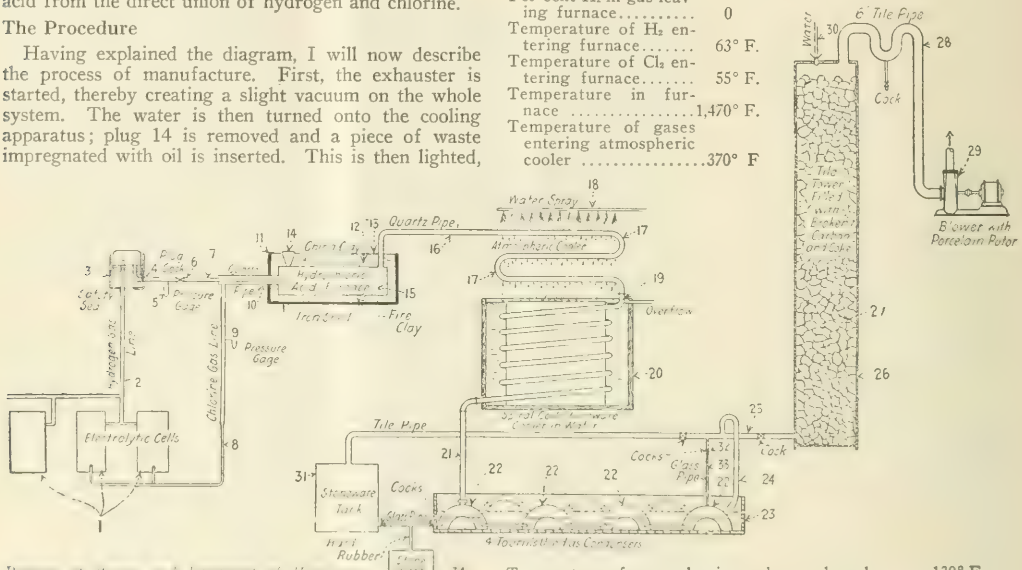


Diagram of Process and Equipment of Hydrochloric Acid Manufacture as Practiced by the Brown Co., Berlin, N. H., May 22, 1922.

Inasmuch as the furnace may have to stand wide variations of temperature according to the purity of the gas, it is necessary that the inlet and outlet pipes be made of a material which must not only withstand the action of the acid at these high temperatures but take care of these wide temperature ranges. After much experience we have found nothing to take the place of fused quartz. Its extremely low coefficient of expansion renders it invaluable for this purpose. It is this low coefficient of expansion which allows us to spray it while white hot, with water, and yet not crack it.

Fused quartz, however, will not stand a temperature of over 1200° C. nor will it stand that long, so it is absolutely necessary that the temperature of combustion be reduced far below the theoretical. Inasmuch as a vacuum is always maintained on the chlorine side of the cells, the necessary amount of air will suck in with the chlorine if too much care is not taken with that part of the cell to make it tight. We keep about an inch of water pressure on the hydrogen part of the cells.

Of course the temperatures actually obtained at different parts of the process will depend upon such variables as concentration of the Cl_2 used, quantity of Cl_2, excess of H_2, air leaks, cooling water used, etc.

Operating Data and Directions

In order to give an approximate idea of at least the minimum range of temperatures, I obtained one day recently the following data. Owing to lack of production the cells were run at a very low amperage so that the amount of hydrogen and chlorine produced was extremely small, while the air leakage was necessarily an increased percentage of the total.

Per cent Cl_2 in gas entering furnace................	4.0
Per cent H_2 in gas leaving furnace..........	0
Temperature of H_2 entering furnace.......	63° F.
Temperature of Cl_2 entering furnace.......	55° F.
Temperature in furnace	1,470° F.
Temperature of gases entering atmospheric cooler	370° F
Temperature of gases leaving submerged cooler....	130° F.
Theoretical production of HCl for day, pounds....	121

The essential factors involved in the most successful operation of this system are:

(1) Continuous operation.
(2) Maintaining of H_2 supply under a small pressure to exclude possibility of air leaks.
(3) Use of strong Cl_2 gas with a large excess of H_2 to keep down operating temperatures.
(4) Extreme care in the starting of the system.
(5) Plenty of cooling water.

There are different methods of starting up the furnace, but probably as good a one as any used is as follows:

(1) Start blower at end of system.
(2) Insert piece of waste, well soaked in kerosene oil through the small hole at top of furnace. Ignite and start H_2 into furnace. When it gets burning well, insert earthenware plug and cover over with china clay.
(3) In a few minutes allow the Cl to be drawn into the furnace.

If carried out in this manner, a good start is obtained, and the possibility of blowing up the whole apparatus is reduced to a minimum.

From the above it will be seen that the process is extremely simple both as to construction and maintenance. The process requires absolutely no labor in that it runs itself so long as the cells are running. This plant thus will run weeks without anybody paying any attention to it, with the product turned out regularly. It is in effect the only manufacturing plant that I have ever seen of which I heartily can approve. We can have no labor troubles here for there is no labor.

Townsend Hydrochloric Acid Process

CLINTON P. TOWNSEND, of the Hooker Electrochemical Co., has devised apparatus and process for the production of hydrochloric acid whereby he seeks to improve upon the present commercial method. In burning chlorine in an atmosphere of hydrogen the gaseous hydrochloric acid produced is abstracted from the effluent gases by absorption in water in a tourril or tower, or tourril and tower system.

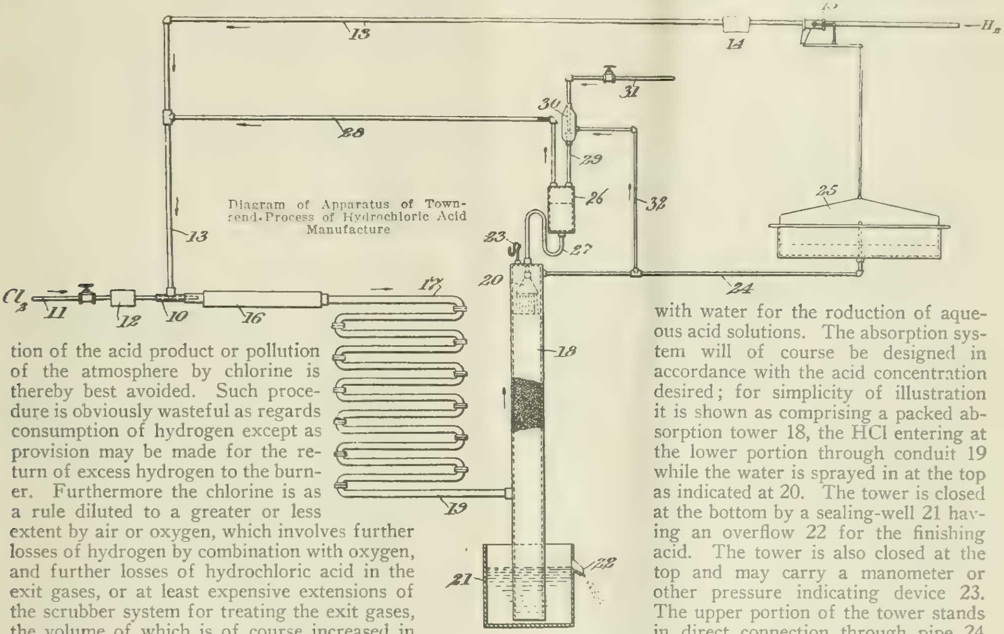


Diagram of Apparatus of Townsend Process of Hydrochloric Acid Manufacture

In the manufacture of hydrochloric acid by this method it is necessary to employ hydrogen in very material excess of the reacting proportions, since contamination of the acid product or pollution of the atmosphere by chlorine is thereby best avoided. Such procedure is obviously wasteful as regards consumption of hydrogen except as provision may be made for the return of excess hydrogen to the burner. Furthermore the chlorine is as a rule diluted to a greater or less extent by air or oxygen, which involves further losses of hydrogen by combination with oxygen, and further losses of hydrochloric acid in the exit gases, or at least expensive extensions of the scrubber system for treating the exit gases, the volume of which is of course increased in proportion to the presence of nitrogen or other inert gases.

According to Mr. Townsend's invention, chlorine and hydrogen, both of which should be substantially undiluted, although they need not necessarily be dry, are caused to unite in a system which is closed to the escape of gas. The chlorine is admitted to the system in a regulated and constant stream, whereas the admission of hydrogen is so controlled as to maintain a substantially constant pressure in the system. A suitable pressure regulator is provided and operates by controlling the inflow of hydrogen.

The Apparatus

In the accompanying diagram, which illustrates one form of apparatus, 10 indicates a burner which may be of silica, and which receives pure chlorine gas (chlorine evaporated from the liquid state) through a supply pipe 11 having a sensitive control valve and a metering device 12. In operation the chlorine supply is maintained as nearly constant as practicable, and accordingly the chlorine supply valve may be either automatically or manually controlled.

Hydrogen is supplied to the burner 10 through main 13, in which is a metering device 14 and an automatic-type control valve 15, the latter controlled by the hydrogen gasometer 25 functioning as a pressure regulator. This regulator serves to maintain a substantially constant pressure, whether atmospheric or above or below atmospheric, throughout the system.

The combustion chamber 16 for the hydrogen-chlorine flame also may be of silica ware. The acid gas first traverses a cooling system 17, and passes thence to the absorption system in which it is brought into contact with water for the roduction of aqueous acid solutions. The absorption system will of course be designed in accordance with the acid concentration desired; for simplicity of illustration it is shown as comprising a packed absorption tower 18, the HCl entering at the lower portion through conduit 19 while the water is sprayed in at the top as indicated at 20. The tower is closed at the bottom by a sealing-well 21 having an overflow 22 for the finishing acid. The tower is also closed at the top and may carry a manometer or other pressure indicating device 23. The upper portion of the tower stands in direct connection through pipe 24 with the pressure regulating gasometer 25.

The hydrogen pressure chamber 26, through which the absorbing water is introduced into the absorbing system 18, communicates at its bottom with the top of the absorbing tower 18 through a water-sealed pipe 27; at its upper portion it is connected by branch pipe 28 with the main hydrogen supply line 13, and by pipe 29 with a water injector 30. The latter receives its supply of water under pressure through valved pipe 31, and communicates through a branch pipe 34 and pipe 24 with the upper portion of the absorption tower 18.

The Procedure

Hydrogen is first admitted through the valve 15 and allowed to fill the system, displacing the air, whereupon the seals are filled and the system closed to access of air, the hydrogen supply valve remaining open until a slight positive pressure is noted at the manometer 23.

The water injector 30 is then started in operation to supply water to the absorbing tower, at the same time by its injector action drawing hydrogen from the tower through the branch pipe 32 and forcing it under slight pressure to burner 10, through pipes 28 and 13. The flow of hydrogen is in the direction indicated by the arrows.

---

*U. S. Pat. No. 1,414,762 issued May 2, 1922.

Pure chlorine is now admitted in regulated and constant supply through the supply line 11, and the burner flame started by an electric igniter. The hydrogen is initially in relatively large excess as compared with the chlorine, thereby insuring complete combination of the latter and an acid free from uncombined chlorine. This acid gas with the accompanying excess of hydrogen passes through cooling coils 17 to the absorption tower 18, in which the hydrochloric acid is absorbed, the aqueous acid overflowing from the well at 22.

The hydrogen circulates continuously through the system as already described. In the meantime additional hydrogen is admitted through the valve 15 in quantity just sufficient to maintain the desired and established pressure within the system. Inasmuch as the amount of hydrogen required to maintain a constant pressure (whether positive or negative) within the system is the amount required to replace the hydrogen which has been withdrawn from the system through combination with chlorine, it will be understood that in the continued operation of the system, and neglecting accidental losses through leakage, etc., the hydrogen and chlorine are supplied to the system in the theoretical combining proportions, although the combination takes places at all times in presence of a maintained excess of hydrogen.

"Do You Use a Chemist in Your Business?"

Those engaged in commercializing chemical service will be interested in the recent publicity of the Arthur R. Maas Chemical Laboratories, 308 East 8th St., Los Angeles, Calif., which embraces a reprint of an article in *Popular Science Monthly* entitled "Do You Use a Chemist in Your Business?" The educational work of Dr. Maas in popularizing the service of the chemist is commendable inasmuch as its results inure to the benefit of all who have chemical service to sell.

If what a man has to sell has value, how desirable it is that those who can be helped by availing themselves of it should be made aware of its value and how it can be secured. This is professional advertising. Attention is directed to Dr. Maas' enterprise in this way, not only because it benefits the class as a whole, but because of its marked contrast to the squeamish attitude of our English brethren, still perturbed with the obsession as to whether or not it is "ethical," whether or not it is "strictly proper" or comports with the dignity of the professional man.

Vitamins in Pork

Ever since the discovery of vitamins in certain foods it has been thought that they were to be found in animal tissue most abundantly in certain of the internal organs, especially the heart, liver and kidneys, but the Bureau of Animal industry, U. S. Department of Agriculture, now announces that they exist in the muscle fibre of beef, veal, mutton, lamb, and pork, and that pork is particularly well supplied with them.

Various cuts of the different kinds of meat were tried, and in every instance pork was found to be relatively rich in vitamins. Pork tenderloins, fresh ham, smoked ham, and pressed boiled ham were tested and the results were nearly the same with all of them. Beef and veal were relatively lower, while the amounts contained in lamb varied a great deal. This new evidence on the distribution of vitamins in meats should not lead to the conclusion that certain meats are of low nutritive value because they are deficient in vitamins. Meat is one of our most important foods and would continue to be so even though it contained no vitamins.

Obsolescence of the Cyanamid Process

From Testimony Before the Senate Committee on Agriculture, May 8, 1922

By Dr. Charles L. Parsons

The cyanamid process is in a state of obsolescence. The plants in France, Italy, Dalmatia, Silesia, Norway and Sweden are closed down. The plant in Canada is not producing cyanamid for fertilizer purposes, but in small quantity for the manufacture of urea, which is used in the manufacture of celluloid and allied material and in producing sodium cyanide, used in metallurgy and for the manufacture of hydrocyanic acid, for killing insects on citrus trees in the West. The plant is running only on a very small output. In the main the cyanamid process is essentially already obsolescent.

I have constantly advised that the cyanamid process was becoming obsolescent while the synthetic ammonia processes—variously designated under the names of Haber process, the Claude process, and the General Chemical process—were rapidly becoming the sole commercial procedure for the fixation of nitrogen for fertilizer and explosive use. The practical obsolescence of the cyanamid plants throughout the world is in entire accord with my prediction.

The remarkable success of the General Chemical Co.'s synthetic-ammonia process in its second installation at Syracuse entirely justifies its first trial installation at plant No. 1 at Muscle Shoals. The fact that a plant to produce 100 tons of fixed nitrogen per day is on the way to completion, using a similar process, at Billingham, England; the fact that an immense cyanamid plant at Odda, Norway, nearly one-half the size of the cyanamid plant at Muscle Shoals, was sold on February 11 for 50,000 kroner, approximately $10,000 present exchange or $16,000 at normal exchange; the fact that this Norwegian plant is planning to convert its water power for use in a synthetic-ammonia process; and the fact that installations of similar synthetic processes are under way in France, Italy, and Japan, is proof of the correctness of the stand I have always taken.

I believe that Muscle Shoals plant No. 2 (cyanamid process) should be kept in a stand-by condition at a cost of something like $100,000 a year. It can be ready to operate at a moment's notice, until such time as we have other reserves, so that there will be no need for keeping it. I am of the opinion that the fixation of nitrogen will be developed most rapidly and most efficiently by private competition, and I believe that private competition is in sight. I do not believe that anyone has a monopoly of nitrogen fixation in this country, and that it is quite possible, and in fact practically certain, that there will be strong competition in the development of synthetic ammonia processes.

The future fixation of nitrogen is going to be through the synthetic processes, although, of course, no one is prepared to state that some wonderful discovery may not be made tomorrow. I do not wish to intimate that we have improved as much as we will ultimately improve it. The use of the synthetic processes is the present outlook.

Dr. Charles H. MacDowell has been appointed chairman of a committee of the American Engineering Council of the Federated American Engineering Societies to promote a national reforestation program to insure a future timber supply, conserve the soil, retard floods and prevent excessive erosion endangering the country's power development, under the general direction of the president of the Council, Mortimer E. Cooley, dean of the College of Engineering, University of Michigan.

Chemical Segregation in America

DR. REDMOND'S opinion, as stated in May CHEMICAL AGE, page 234, is that now is a good time for the American Chemical Society to decide "whether it is a publishing house whose membership, like that of the National Geographic Society, is open to anyone sufficiently interested in the subject of chemistry to subscribe for its publications, or whether it is a professional association like the American Medical Association whose membership is limited to those who have achieved a definite status as a result of either training or experience."

With becoming modesty does CHEMICAL AGE accept the credit accorded it for instigating the scrutiny of segregational methods of American chemists, for it was our discussions for the past two years of this inadequacy which has culminated in the appointment by the council of the American Chemical Society of a "development" committee whose function will be to find wherein the present system of government falls short in its service to American chemistry and to recommend such realignment as may supply the deficiency. This committee comprises four teaching chemists, one production chemist, one business chemist and one editor.

Popular Opinion

In the contention that the American Chemical Society, as personified by the activity of a small self-perpetuating governing group, was subverting the interests of a great body of American chemists, we expressed the opinion of thousands of chemically trained men who saw in its plan to dominate, control and monopolize the intellectual enterprise of a great pursuit, the whole catalog of evils inevitable when government goes into business. Naturally soon would come men with the temerity to inquire if autocracy is the proper form of government for the practitioners of one of the most numerous technical professions, and with the courage and capacity to make their fellows sit up and take notice.

These men believe that no single organization seeking to perform service in the combined fields of science, pedagogy, production and trade in the province of chemistry can encompass, control and perform satisfactorily all the functions that the economic status of the chemically trained man of today and the future demand. They point to numerous organizations that have separated from the embracing complex of heterogeneous interests in response to the call of efficiency, and without any substantial inhibition of the latter's original functions.

If ceramists, electrochemists, glyceride-oil chemists, textile chemists and colorists, fertilizer, cereal, leather and agricultural chemists, etc., who make goods to sell, develop their economic organizations, without disruption of allegiance to the embracing educational society, why should not chemists, who have, distinctively considered, service to sell, invite that segregation which will promote efficiency in its production and distribution, in other words, which will wield influence to give its possessors a distinctive status and to promote their material interests, without sacrifice of usefulness of the educational society whether general or specialized?

The segregational activities of the technical professional man differ from those of the conventional professions of law, medicine, theology, dentistry, and of the numerous groups that serve the people directly, in that the former serves industry in the capacity usually of a corporate employer who looks upon the chemist's service as an element of the cost of production of goods and to be bought at the best advantage.

The buyers of chemical service naturally should promote the educational, scientific society for its function is to provide an abundant supply of help of increasing quality and to spread among the people a bewildering appreciation of the beneficence of chemistry. The purpose of the educational, scientific society pursued to its logical end is to make scientific labor, i.e., chemical service, so cheap that no manufacturer will be without chemically trained help.

After a commodity is in the market the cost of production has no influence on the selling price. Young men looking to industrial chemistry as a career will consider with misgivings an education cost in time and application which will net them no more, if as much, as an apprenticeship to a plumber or a bricklayer, or a carpenter, or a type-setter and with a much briefer period of usefulness and with a tragic lack of adaptability. In fact, it is only when the man is something more than a chemist, is his earning capacity sufficient to enable him to marry and to maintain a home on a basis that will reflect the realization of the aspirations his education has inculcated.

The necessity of organized consideration of the material interests of chemically trained men in industry by the men themselves, generally is admitted.

Shall this be a paternalistic project under the dispensation of a system wherein what is handed down is what is believed will sooth and satisfy with the least incitement to disturbance of the system? Shall it be a revolution of method of management in the embracing popular society dedicated to the promotion of education in the science and art of chemistry, whereby the employed class may make the organization reflect directly their ideas and interests regardless of its primary and basic educational purposes and interests? Or shall it be a separate and distinct professional organization free of the bureaucracy and burden of publication enterprise and dedicated solely to making the most out of the chemically trained man.

Autocracy

Let us consider the place of autocracy and democracy in the government of technical professional men, particularly those practising chemistry in its almost innumerable aspects in industry. In the paleozoic atmosphere of autocracy naturally thrive secret societies and cliques and cabals and agents to report upon and suppress any initiative in the work of organization among chemically trained men, that, instead of creating any division of interest as feared, in fact, strengthens the society by relieving it of incompatible functions sought to be, but poorly, performed.

In the scientific society the individual is expected to pay his dues and to qualify as an intellectual contributor to its educational service. The great majority, however, rising but little above the dead line of mediocrity, is relegated in its activity to the former responsibility and so the "average" individual is heard of but little and, as a rule, only as a part of a curve and usually only when it is ascending.

Centralized management in the hands of a group, passing out place, perquisites and prizes and arrogating to itself the power to discipline and to keep in line the disciples of the faith comports with pedagogical functions. Experience shows this form of government serviceable in the educational, scientific society, for it best reflects the vision and oversight of the "elder statesmen," with none of the distractions of local conditions. It is not concerned with aiding the individual to work out his destiny and does so only as a sop to preserve the system.

American Medical Association

We antedated Dr. Redmond by one and one-half years, for Chemical Age in January, 1921, page 23, first advocated the federal form of government for the American Chemical Society and gave subsequently in numerous discussions of the subject reasons that certainly have taken root.

At the time mentioned, we wrote as follows:

"The national organization should be founded on state lines after the manner of the federal constitution, with the needed simplification of making the presidents of the state sections the supreme advisory committee of the national organization, and which by the delegated authority of the respective state sections would elect the officers of the national organization—to the end that progressive selection of quality shall be assured, with that maximum autonomy in state government that provides quickest response to the stimuli of the local environment.

"The governing body, both in the national organization and the state sections, should be made up of (1) the teaching chemist, (2) the production chemist, and (3) the business chemist, all alert to the problems that beset the industry and the good that they can do.

"The nation and the states in their statistical, development and research departments need the quick cooperation of an organization of the elements of the chemical industries that could speak for the industries, because they constitute the industries. Existing commercial, financial and manufacturing organizations of the respective states would find in this proposed organization a worthy complement of their activities and of equal dignity in their community of purpose.

"In his closeness to a condition demanding correction, and in the democracy of an organization designed for this accomplishment, the individual member could see that its activity would reflect his own enterprise, and hence bring out the nascent attributes inherent in every ambitious man. Contact with his fellows, friction of ideas, competition in a common service, contribute to the recognition of capacity often in directions unrelated to one's daily duties, and serve to mark a man for recognition and for placement where his native capacity may have expression."

In the structure of the American Medical Association we do not find true democracy, for that is a theory, but we do find in medical segregation conditions that are a great improvement upon the methods and management of the American Chemical Society.

The practice of medicine has many points of similarity with the practice of chemistry, chief of which are its universality and the intimacy of the respective relation to public welfare. The American Medical Association is a federation of constituent state associations, which in turn, embrace the county medical societies as the units of organization of the system and the foundation of everything above them. We already have emphasized the increasing prominence of chemically controlled industry and the growing investment in the facilities of chemical utilization in every state, and of the necessity of the organization of the state chemical society to represent, with other organized activities of the state in finance, production, transportation and trade, the place of applied chemistry in the economy of the state.

The state chemical society would constitute the embracing popular chemical educational organization of the commonwealth; from which would crystallize capacity in the membership of the professional state society which would be the state section of the American Institute of Chemistry.

The state section of the American Institute of Chemistry would be concerned solely with the material welfare of its classified members, free from the special influences of the state chemical society which would embrace all interested in chemistry, from whom would flow, as at present, the funds to support the national educational activities of the federated state chemical societies. This aspect of chemical segregation already has been amplified and is along the lines which Dr. Redmond apparently had in mind when he recommended the American Medical Association as a model for the present unsatisfactory system of chemical segregation in America.

Dr. Paul Van Cleef's Opinion

Dr. Paul Van Cleef, editor-in-chief of *The Chicago Chemical Bulletin,* and of the department of chemistry, Chicago University, rivals Dr. Redmond, as reported in May Chemical Age, in candor in the expression of his opinion of the necessity of "inventory-taking" in the American Chemical Society. This opinion, reproduced from the admirable *Chemical Bulletin,* follows:

The American Chemical Society has discovered after a long period of prodding that there are certain things in its make-up which need investigating. Its manner of organization, the distribution of its funds, the condition of its publications, yes and even the efficiency of its ruling branches have been talked about in this connection. Whatever the facts are they should be faced frankly for these matters represent the moral character of the Society.

At the Birmingham meeting the President was authorized to appoint an investigating committee. As head of the Society, the President long ago on his own account could have investigated abuses within it did they exist. He did not recognize this prerogative. That the Society saw the necessity for appointing an investigating committee was not a tacit but an avowed criticism of those charged with the conduct of the Society. The President has therefore been placed in the rather awkward position of appointing a committee whose duty must carry it even into his own office.

The committee must work under his direction. Yet it may well be asked, "Can he be in sympathy with its purposes when he did not undertake a similar work of his own accord?" Or granting his complete harmony with the plan: "Will not a large element in the Society still remain skeptical of the Committee's thoroughness." It is unfortunate that the President was not relieved of this position which surely must have proved embarrassing to him. The President of the Society in the opinion of *The Chemical Bulletin* ought to have refused the responsibility and placed it where it belonged—on the shoulders of a representative group in the Society. No charge of personal bias could have been raised.

Chemists and the American Chemical Society stand at the crossroads of progress. They may choose the path which takes them over the hill to self-esteem and a recognized position in the world or that way which goes down by the sea of mediocrity.

J. M. Lowe, superintendent, Edgewater, N. J., plant, Midland Linseed Products Company, has been appointed general superintendent of the company.

Cascade System of Sulfuric Acid Concentration

Improved Procedure and Equipment in the Continuous Cascade Concentration of Sulfuric Acid and Other Liquids

By L. A. Thiele, Ph.D.
Consulting Chemical Engineer

L. A. THIELE, PH.D.,
Consulting Chemical Engineer.

THE continuous cascade sulfuric acid concentrator originated in the plant of Chance Brothers. Oldbury, England, in 1871. Before that time sulfuric acid was concentrated in glass retorts holding about 175 lbs. each, which were set in a sandbath on the same level in a galley furnace. Gridley (B. P. 1243, 1871) changed this intermittent arrangement into a continuous one by placing these glass retorts terracewise in an obliquely ascending furnace, connecting the retorts by siphons in such a manner that the top retort was fed with fresh acid, which after being concentrated to some extent flowed to the next lower retort and so on through the series of 4 or 5, while the concentrated oil of vitriol was discharged continuously from the lowest retort which had its position in the hottest part of the furnace.

While in later years the furnace was greatly enlarged and the large retorts reduced in size and appearance, the principle as originally adapted by Gridley did not change. Porcelain beakers followed the glass retorts and were superseded by fused silica (vitreosil) dishes in 1906, by shallow vitreosil pans, and by dishes and pans of special cast iron high in silicon in about 1910. More attention also was paid to the pre-concentration of the acid before running into the cascade proper, by adding pre-heaters, long basins, towers, interposing settling tanks and sand-filters to cope with muddy acid.

The furnace underwent changes owing to different fuels, as coal, coke, gas and oil came into use. But the most prominent change was in the size and appearance of the cascade dishes or basins, based upon the fact that a more rapid evaporation and consequently larger production was obtained the more the depth of the acid stream was reduced. Given an increased capacity of the heat generator, it stands to reason that the capacity of a cascade concentrator can only be increased by either increasing the length of the channel or by increasing the heating surface of the cascade dishes or basins.

To increase the heating surface of the cascade basins without lengthening the channel and at the same time to reduce the depth of acid film running down the cascade by using basins with corrugated bottom instead of semi-spherical dishes or shallow, flat-bottom pans, is the purpose of U. S. Patent 1,380,689 (1921). The size of these basins is 12 in. x 12 in. x 6 in. deep; they have 4 deep corrugations in the bottom as illustrated in the accompanying diagram, Fig. 2. Within each corrugation a baffle, which is also corrugated at the lower edge dipping into the acid, is interposed, compelling the acid to flow in a wave-like motion through each individual basin in a stream of less than ¾ in. in depth on their downward course through the entire length of the channel. As each corrugated basin has an effective heating surface of 3 sq. ft., which is 2½ to 3 times as large as that of dishes or shallow pans respectively, a greatly increased capacity of cascade concentrators is thereby obtained.

A string of 50 of these basins has a capacity of 16-18 tons of 92-93 per cent acid, or 12-13 tons 95-97 per cent acid per day with a fuel consumption of 12-16 per

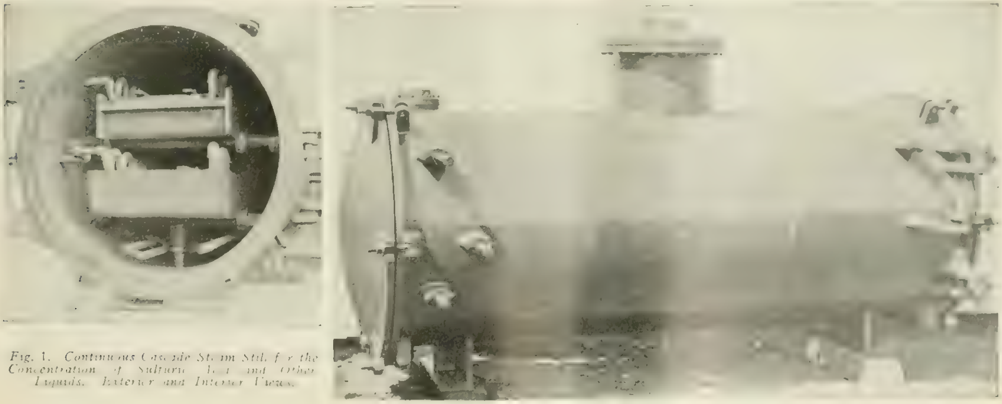


Fig. 1. Continuous Cascade Steam Still for the Concentration of Sulfuric Acid and Other Liquids. Exterior and Interior Views.

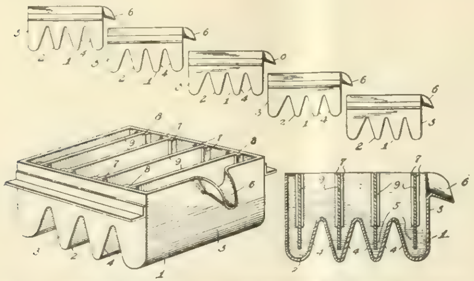


Fig. 2. Details of Sulphuric Acid Concentrating Basin with Corrugated Bottoms and Baffles.

cent based upon the weight of the final sulfuric acid.

Continuous cascade concentration is not only applicable to the concentration of sulfuric acid, but to a great variety of other products, such as chloride of zinc, and offers a great advantage in processes of distillation, where continuous operation is desirable, as, for instance, in the production of gasoline by the absorption process, or in the extraction of oils, fats, waxes, grease and the like, where the oil has to be freed from the volatile solvent, or for solvent recovery in general.

The illustrations, Fig. 1, show the application of the cascade principle for a "continuous-cascade-steam-still," embracing the exterior appearance of the still and an inside view, while Fig. 3 shows the corrugated cascade basins completely equipped with baffles and heating coil and with the removable baffles in place; Fig. 4 is the coil which fits into each corrugation and sits between each baffle.

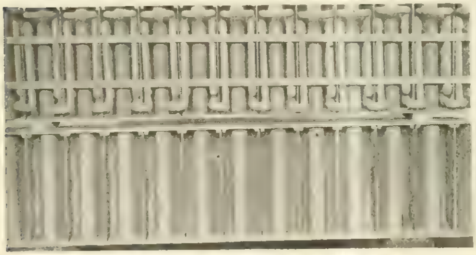


Fig. 3. Corrugated Cascade Basin Equipped with Baffles and Heating Coil.

Operation

Two or more of the larger cascade basins, such as are used in pre-heating acid, are placed horizontally, one over the other into a prostrate tank. Steam circulates through each coil in each cascade basin; in the bottom of the still a perforated steamcoil is arranged and outlets for oil provided as well as tap for water, as shown in Fig. 1.

The oil, charged, for instance, with gasoline, flows in the first corrugation of the top cascade-basin, describes a wave-like motion around and between the steamcoils until it reaches the end of the basin when in overflows to the next lower basin, continuing on its course, until it arrives at the bottom where it comes into contact with live steam, whereby the last traces of volatile solvent are liberated. The oil flows off through the cage, while the gasoline vapors leave at the top of the still, are condensed in a separate condensor and re-enter the circuit.

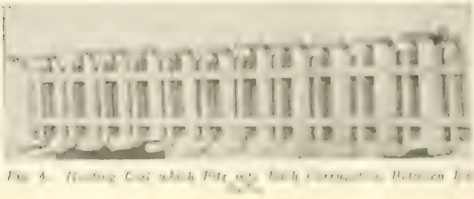


Fig. 4. Heating Coil which Fits into Each Corrugation Between Each Baffle.

The still as shown in Fig. 1 has a diameter of 3 ft. 6 in. x 9 ft. long, contains 150 sq. ft. of effective heating surface and a capacity of 2,500 gallons per hour when using steam of 90 lbs. pressure. Gasoline vapors are liberated in fifteen minutes from the time the oil enters the still.

American Oil Chemists Society

13th Annual Convention at New Orleans, June 7-8, 1922

Mississippi River floods caused a postponement of the convention date, which, together with hard times in the cotton oil industry, militated against the usual good attendance. The distribution of printed committee reports facilitated their speedy discussion and disposition and allowed time for the consideration of a number of important papers.

Dr. Geo. S. Jamieson, chemist in charge, Oil, Fat and Wax Laboratory of the U. S. Bureau of Chemistry, presented some of the results of his laboratory's investigations of the composition of cotton-seed oil in a paper on "The Analysis of Crude Vegetable Oils." He outlined a method for the determination of the actual quantity of gylcerides present in crude oils and said that there were other substances in cotton-seed oils beside free fatty acids which combined with caustic soda in the usual refining processes. A small quantity of these had been isolated and it was proved that they contained phosphorous and other inorganic radicles. When the chemical identity of the non-fat bodies in oils has been determined and their effect upon commercial refining operations is known, it will be much easier than at present to judge of the efficiency of factory refinings.

Dr. David Wesson, technical director, Southern Cotton Oil Co., exhibited the new E. K. colorimeter, which he had been studying as a possible solution of the present difficulties in satisfactorily grading oils for color. He also showed lantern slides of another instrument which is being perfected by the Keuffel & Esser Co., and a number of color absorption curves of oils and Lovibond glasses. Dr. Wesson said tha K. & E. instrument it would be possible to tell when an oil had been partly bleached and also whether or not any given refined oil was bleachable.

The silver loving cup for most accurate work in the determination of both oil and ammonia in 38 samples of oil meals, which is given annually by the Society, was awarded at the banquet to Mr. H. B. Battle. A number of certificates for proficiency in the analysis of oils, fertilizers, soap stock and fats were distributed by Herbert Bailey, chief chemist, Southern Cotton Oil Co., as a part of his report on the work of the cooperative analytical program.

The Society voted to incorporate under the laws of the State of Louisiana, and after the final session the officers for the coming year went to their attorney's office and signed the incorporation papers. For the ensuing year the following officers were elected: President, L. M. Tolman, chief chemist, Wilson & Co., Chicago; vice-president, H. B. Battle, Montgomery, Ala.; sec.-treas., Thos. B. Caldwell, Wilmington, N. C.; Editor, Chemists Section Cotton Oil Press, Herbert Bailey, Savannah, Ga.

Manufacturing Chemists' Association

Report of Executive Committee for the Year Ended May 31st, 1922

By Henry Howard, Chairman

THE Manufacturing Chemists' Association this year completes a half century of existence and it seems fitting to your Executive Committee on this notable anniversary to preface its report of the last year's activities with a word of felicitation over the accomplishments of the past. The association has a most commendable record of useful and valuable service in giving force and direction to cooperative work undertaken for the benefit of the chemical industry. Organized in 1872 by a group of leading manufacturers of heavy chemicals, the association has steadily broadened the scope of its work, enlarged its membership and grown in influence and authority. As the complexities of our industrial and economic life have developed, bringing also ever increasing extension of government contact with business, the need for an association to handle problems thus arising has become more apparent.

Business, Politics, Committees and Connections

The matters that pressed for attention during the year and the problems to which your Executive Committee is now giving consideration reflect fairly accurately the still unsettled state of industry and the uncertainty and indecision at Washington which aggravate that condition. One year ago we reported hopefully upon the progress of tariff legislation. It seemed reasonable to expect enactment of the pending measure before adjournment of that session of Congress. Twelve months later we again make a progress report, and with the encouraging assurance of responsible majority leaders that we shall have a tariff bill.

Other proposed legislation affecting our interest likewise has received attention. The more important measures upon which we have recorded our position are referred to later. The matters of current concern which have come to be largely routine in character have had full consideration of your Executive Committee. It has been deemed expedient to delegate much of this business to standing committees of the association and we now have actively functioning committees on the following subjects:

Carboy test; traffic; acid tank cars; specifications of steel drums; specifications for drums not to be refilled or reshipped; zinc chloride tables. All findings and recommendations are reported to the Executive Committee and no action committing the association is taken except on official authorization.

We have maintained membership in the National Industrial Conference Board, the National Foreign Trade Council, and the Chamber of Commerce of the United States. From each of these organizations we have derived distinct advantages during the year. Our relations with the Bureau of Explosives and with the Classification Committees of the railroads continue very satisfactory.

Tariff

The delay in passing the tariff bill is disappointing and exasperating, and undoubtedly much of the uncertainty prevailing in business is due to the hesitation of manufacturers and buyers to make commitments prior to enactment of the measure.

All dilatory tactics known to parliamentary practice have been employed by the opposition to delay progress of the bill. Rumors and whisperings that the majority party was seriously considering abandonment of tariff legislation also have been circulated with the object of discouraging supporters of the measure, but these obstructionist methods are appraised at their true value by the party in control and they will fail of their purpose. We have the word of responsible Republican leaders that a tariff bill will be passed and will become law before the present session of Congress is adjourned.

American Valuation

The association was the first organization publicly to go on record in favor of American valuation, and from the date of its first announcement in January, 1921, our members have consistently advocated that basis for assessment of ad valorem duties. Your Executive Committee not only presented facts and arguments to the Finance Committee, but took an active part in organizing sentiment throughout the country in its favor.

Our association joined in request to the National Association of Manufacturers for a call for a convention representative of American industry, which met in Washington on January 30, 1922. At this convention resolutions were adopted favoring American valuation, and the committee waited upon the Finance Committee to emphasize the necessity for incorporation of American valuation as a principle in the pending tariff bill.

It has been a matter of disappointment that the Finance Committee rejected the House American valuation provision, but we are assured by Chairman Fordney of the Ways and Means Committee that he and his conferees will insist upon its inclusion in the bill.

Patent-Working Clause
Revival of Convention of 1909 with Germany

Some months after he assumed office, Secretary of War Weeks began to feel alarm at the increasing number of American patents involving munitions, chemicals and war appliances which was being issued to German nationals or was being asigned to them. In a letter to Senator Johnson, chairman of the Senate Patent Committee, he pointed out that by operation of the American patent law those patentees were relieved of any obligation to work the patents in the United States, and furthermore, were privileged to deny applications of Americans for licenses to manufacture under the patents. The result, he said, was seriously to affect our preparations for national security.

Secretary Weeks' letter revived the demand for a change in our patent laws that would provide a working requirement and Senator Stanley introduced such a bill in the latter part of last year. Objections to the form in which the bill was prepared caused its withdrawal, and later Senator Stanley introduced the bill, S. 3410, upon which hearings were called by the Senate Patent Committee.

In the meantime the Treaty of Peace with Germany was ratified and took effect on November 11, 1921. One of the sections of that treaty provided that the United States might revive any former treaty or convention that had been abrogated by the war, upon mere ratification to the German government, provided such right was exercised within a period of six months from ratification of the Treaty of Peace. On February 22, 1922, the Senate adopted a resolution authorizing the

President to give such notice of intention to revive the Patent Convention of 1909. Your chairman, who happened to be in Washington on the following day, obtained an interview with Secretary Weeks and Under-Secretary of State Fletcher and upon representation that revival of such a treaty would defeat the purposes of a working clause in our patent law so far as Germany was concerned, the notification of renewal was held up.

The Senate Patent Committee then announced a hearing on the Stanley working clause bill for April 6, 1922, and at that hearing, a representative of the War Department presented the case from the national security viewpoint, asserting that it was a matter of vital interest that the patent law be amended in order that full advantage might be taken of all processes and inventions having relation to military preparedness. The proposed change was vigorously assailed by Frederick P. Fish and other representatives of the American Patent Bar Association. The hearing adjourned to May 1.

In the interval both sides joined issue on the question of reviving the patent convention, each bringing to bear all possible influence with the State Department in support of its position. Those favoring the old patent relation with Germany finally were successful and on May 8, three days before the expiration of the six months limit, the German government was notified by our Ambassador at Berlin that the United States elected to revive the patent convention.

The weight of legal opinion is apparently agreed that this treaty takes precedence of any statute that may provide a working clause requirement, unless Congress abrogates this treaty by appropriate legislation. Senator Stanley announced that he would continue to press for favorable consideration of his measure, the necessity for which becomes even more urgent with the restoration of the treaty.

At the last hearing before the Senate Patent Committee, the chairman of your Executive Committee presented a suggested draft of an amended bill which was designed to overcome some of the objections urged by patent attorneys to the Stanley bill. The opposition declined to accept that bill, but Senator Stanley adopted it and made it a substitute for his bill, which is still under consideration.

Patent Office Relief Bill

On February 16, 1922, the President signed the bill increasing salaries and personnel of the patent office, thus marking successful conclusion to efforts which had extended over a period of two years to bring a measure of relief that would effect an improvement in the patent office.

Two years ago a similar bill was introduced and passed both houses, but was amended in the Senate to provide for licensing of patents on a royalty basis under the administration of the Federal Trade Commission. This rider was so objectionable that the Manufacturing Chemists' Association felt it necessary to oppose it, and largely through the opposition which we initiated that bill failed to become law.

With the convening of the 67th Congress and introduction of a new bill the association extended its full support and materially assisted in bringing about the gratifying result referred to.

Pollution of Waters by Factory Waste

The increasing use of fuel oil by coastwise and ocean steamers has brought with it the problem of providing for disposition of oil waste discharge, the damaging effects of which are felt along the Atlantic and Gulf Coasts.

In response to protests of citizens in coast towns and cities, there have been introduced in Congress several bills to prohibit not only discharge of oil waste, but of all factory waste as well. Two hearings were granted parties in interest by the Rivers and Harbors Committee of the House, and at each of these hearings the Manufacturing Chemists' Association was represented by its secretary, who urged the committee to defer consideration of any measure affecting discharge of factory waste until a complete investigation could be made of the character of such waste and its effect upon fish life and abutting property. Shortly after the second hearing, which was held on December 7 last, announcement was made by the chairman of the committee that proposed legislation would be confined to the subject of oil-waste discharge, and that provision would be made for an investigation of factory waste along lines recommended by your secretary.

It seems proper at this point to report that this problem is one which we shall probably have to face sooner or later. Heretofore the issue has been determined locally by municipal or state governments, but notwithstanding sound legal authority denies the power of Congress to legislate upon that question as an encroachment upon the rights of states, we should make such provision to meet the issue when it appears nationally as prudent judgment dictates.

Soldiers' Bonus

This year as was the case a year ago, the proposed soldiers' bonus is a live political question. Unhappily, it is also a question of very great financial importance, even though its determination so far as Congress is concerned, may be based solely upon political considerations. The bill which will call for a total expenditure of more than five billion dollars, has passed the House and seems in a fair way to pass the Senate. The only protection taxpayers have against this proposed raid on the treasury, is the President's veto, and it is generally understood that he will not hesitate to place his executive disapproval on the bill if it comes to him without a sales tax. Since the farmers emphatically declare against a sales tax, we can confidently look for a veto message.

Commercial Bribery

Your Executive Committee gave its endorsement to the bill H.R. 10159, to prohibit certain practices which are defined as commercial bribery. This measure was given careful consideration by the House Judiciary Committee and a great deal of thought was devoted to its construction. The bill passed the House on June 1 and is now pending in the Senate. It is the belief of your committee that such a law is needed and will have a wholesome effect in removing improper practices which react harmfully upon all business.

Production Statistics

About a year ago Secretary Hoover suggested to the Executive Committee the desirability of furnishing statistics of production, stocks on hand and sales of sulphuric acid as an index of the chemical industry. At his invitation, a committee of the association met in conference with him in Washington. He outlined the character of statistics he desired, explaining it was his belief that such information would be valuable to the chemical industry and to industry in general.

A committee consisting of President Charles L. Reese, Mr. Henry Howard and Mr. W. H. Nichols, Jr., was appointed to give consideration to Mr. Hoover's plans. They went into the question very thoroughly and arrived at the conclusion that the information sought would impose considerable work and expense upon manufacturers, while any possible good coming from publication of such information was of very doubtful value. They had a later meeting with Mr. Hoover and explained to him that in the manufacture of sulphuric acid, local needs were served, and production and sales, being governed by local conditions, would be valueless as an index to national conditions. Mr. Hoover was convinced of the impractical value of the proposed undertaking and the matter was abandoned.

Reduction in Freight Rates

When the Interstate Commerce Commission announced hearings to begin on December 7, 1921, for consideration of revision of existing freight rates, your Executive Committee adopted a resolution urging that if the commission were to order reductions, they be applied on a percentage basis to effect a horizontal lowering of the rates.

This resolution was circulated to our membership and given approval. Your secretary was directed to present the action of the Executive Committee to the Interstate Commerce Commission, and our position therefore constitutes a part of the record in the proceedings which resulted in horizontal reductions, approximating 10 per cent., announced May 16, 1922, applicable to products of our manufacture and effective July 1, 1922.

Spanish Export Tax on Pyrites

In August of last year your committee learned that the Spanish government was seriously considering imposing an export tax of 8 pesetas per ton on pyrites. In cooperation with the National Fertilizer Association protests were filed with the Madrid government through the Commercial Attache of the Department of Commerce, and through our Ambassador to Spain.

Representations that such a duty would react unfavorably upon the commerce of the United States and Spain were also made direct to the Spanish Ambassador at Washington in behalf of the association. As a result of the protests in which our association joined, the Spanish government reconsidered the tentative draft that had been published and adopted a tax of 15 centavos per metric ton. In reporting the successful outcome of efforts in this matter, we desire to make full acknowledgment of the unremitting energy with which our government representatives at Madrid labored for American interests.

The Chemical Foundation, Inc.

The Chemical Foundation has made substantial progress during the past year, but owing to depressed business conditions it has operated at a loss. Mr. Garvan, however, last month stated that with operating expenses curtailed to the utmost and royalties beginning to increase again, it is now paying its way. The Chemical Foundation is greatly to be commended for the educational work it has carried out during the past year in bringing to the attention of the general public facts regarding the importance of the chemical industry from the point of view of national defense and public health.

National Industrial Conference Board

The work of the board to which your association contributes both by financial aid and by the personal efforts of your president and chairman of the Executive Committee, is becoming more and more widely known and favorably regarded, etc. Its cost of living figures are generally accepted as the best. But perhaps you do not fully appreciate the extent to which individual members of our association may profit by this organization. The board stands ready to make special economic investigations, regarding the condition surrounding your workmen which in cases of labor troubles may be very useful. The anthracite coal miners and railroads have already availed themselves of this service. In addition you may obtain from them copies of research reports and charts of great interest at a cost only sufficient to cover printing.

Current Chemical Patents and Patent Problems

By Lloyd Van Doren, Ph.D.

Consulting Chemist; Patent Attorney, The Chemical Foundation, Inc.

IT is gratifying to note that the consensus of opinion with respect to the Stanley Bill, as amended April 20, 1922, appears to be crystallizing in its favor; the resolution adopted May 13 by the Patent Committee of the American Chemical Society without reservation, favors the principle of the Stanley Bill.

The revival of the 1909 Patent convention with Germany renders the passage of legislation identical with or similar to the Stanley Bill highly imperative if American industry is to be protected from the inroads of unjust foreign competition. This Patent convention provides as follows:

> The provisions of the laws applicable, now existing or hereafter to be enacted, of either of the contracting parties, under which the non-working of the patent, working pattern (Gebrauchsmuster), design or model carries the invalidation or some other restriction of the right, shall only be applied to the patents, working pattern (Gebrauchsmuster), designs or models enjoyed by the citizens of the other contracting party within the limits of the restrictions imposed by the said party upon its own citizens. The working of a patent, working pattern (Gebrauchsmuster), designs or model in the territory of one of the contracting parties shall be considered as equivalent to its working in the territory of the other.
>
> This Agreement shall take effect from the date of its promulgation and remain in force until the expiration of 12 months following the notice of termination given by one of the contracting parties. The present Agreement shall be ratified and the ratifications shall be exchanged at Washington as soon as possible.

It is obvious that any legislation directed only toward compulsory working by patentees who are residents of foreign countries would not accomplish the desired end, since citizens of Germany would not thereby be required to work their patents in this country in view of the fact that the same requirement would not devolve upon our citizens.

A law to be effective, therefore, must consider this possibility; the Stanley Bill as amended appears to provide that which is necessary for a due and proper protection. It has repeatedly been contended and it has now been stated by a former Commissioner of Patents that

> "Germans have taken out coal-tar and other chemical

patents in this country more than Americans and all other foreigners combined, and oftentimes they pigeonhole their American patents, neither manufacturing here themselves nor allowing others to manufacture here, but they do manufacture extensively in their own country, and export to us sufficient to supply such part of the demand here as will take the German-made goods at high prices."

The conditions confronting the chemical industry particularly at this time, are the same which confronted the industry both in England and in Canada, and there have been remedied by a compulsory license law. It follows directly, therefore that a compulsory license law is the remedy for the condition here, and such a law might advantageously apply to all suppressed United States Patents whether there may exist corresponding foreign rights or not.

Whenever a patent is not directly used to develop an industry, but is wholly or even partly suppressed, with prejudice to American industry, any injured party or any party willing to manufacture ought to be able, on demand, to obtain a license under that patent at a fair royalty, so that he can make, use, sell and export lawfully, and yet with a legitimate royalty to the owner of the patent.

Not every patentee should be compelled to give a license; not those giving the public the benefit by manufacturing sufficiently to meet the demand at a fair price, but those not manufacturing and who, as the law is now, will not let anybody else manufacture, should be required to give a license at a fair royalty to one who can and will manufacture. This is altogether different from compulsory working. Such a simple amendment would remove every objection to the patent system and would be a benefit to the public without taking away any rightful interest of inventors.

Eliminating Color from Caustic Alkali

In the production of caustic potash or other caustic alkali great difficulty has been experienced in obtaining a colorless product because of the avidity with which such concentrated fluid body of caustic potash attacks organic matter or mineral compounds of different kinds with which it is brought into contact and which have a staining or discoloring effect upon it, and the same is true of other caustic alkali.

Thomas C. Meadows and Herman D. Ruhm, of New York City, have discovered that by passing a current of electricity through concentrated solution of caustic alkali, or through the caustic alkali while it is in a state of fusion or otherwise fluid, all discolorations will be removed and a bleached or colorless product will result. Messrs. Meadows and Ruhm confess their inability, in view of the limited knowledge as to what electricity really is, to explain the nature of the action of the electric current when so used. It is possible that the small amount of chlorides almost always present in caustic potash are electrolyzed and hypochlorites formed, or chlorine liberated, acting on the coloring matter in the ordinary manner of hypochlorites, or chlorine, when used as a bleaching agent. Again, it may be that the water in the solution is decomposed and the nascent oxygen serves as the bleaching agent, or it may be that the coloring matter itself is an iron or other compound which is electrically disassociated by the electric current so that the objectionable color disappears. On the other hand it is possible that the true explanation may be even different. We only know, positively, the gentlemen state, that which takes place, but not the reason therefor, in Pat. No. 1,415,186.

The current is applied by connecting one pole of an electric generator to the vessel in which the solution is contained or in which the alkali is fused, so that the vessel acts as a cathode, and to insert into the fluid contained in this vessel an anode of platinum, carbon, graphite, iron oxide or other available anode material, or even the bare copper wire or other conductor connected to the other pole of the generator, the strength of the current being regulated as desired and the treatment being continued until the desired bleaching effect has been produced.

Improved Twitchell Reagent

A process for the production of sulpho-aromatic compounds which may be used for the decomposition of fats by which it is hoped to overcome the weak points of the Twitchell process, viz., an excessive decoloration of the resulting fatty acids, and a long reaction time, at least 30 hours, is the subject of Patent No. 1,416,284, granted to Arne Godal, of Vestre, Norway. In the production of the reagent the following method is used:

Oleic acid is mixed with naphthalene in equimolecular proportions. To the mixture is then added a solvent as benzol, in such quantity as to produce a clear solution. To the solution is now added sulphuric acid under constant cooling and stirring, a temperature below 5° C. being maintained. When a substance has been formed which with water produces a clear solution the addition of sulphuric acid is interrupted and the mass is left at rest for 12-24 hours. The mass is then flowed as a thin jet into water under constant stirring and cooling, a temperature of below 5° C. being still maintained. When left to stand a layer of acid will separate at the bottom and is then drawn off. This operation is repeated several times until the aromatic sulphonic acids are removed. After the last washing with dilute sulphuric acid and after 12-24 hours standing the acid layer is drawn off very cautiously, whereby the remainder is obtained substantially free from acid.

Water is now added to the remaining liquid under stirring. On standing two layers will be formed again, the lower one consisting of an aqueous solution of the active reagent in a pure condition while the upper layer will consist of unchanged oleic acid and naphthalene as well as the solvent benzol. This latter mixture of substances is then again subjected to sulphonation, whereby further quantities of the reagent is obtained.

From the aqueous solution the reagent when desired can be obtained in a concentrated (nonaqueous) condition by means of evaporation under reduced pressure.

In the employment of the reagent the fat is first treated with sulphuric acid of ½ per cent strength, separated from the acid water and then introduced into a decomposition vessel where is added from .5 to 2 per cent of the decomposition agent. The mixture is then heated to 100° C. with continuous agitation and after 6-20 hours the splitting of the fat has progressed to 80 per cent. The mixture then is allowed to stand for a couple of additional hours for the separation of water, which is drawn off, whereupon fresh water is added and stirring continued for 2-6 hours, yielding a splitting of 95-98 per cent. The reagent is recovered from the glycerine water by precipitating with calcium or barium carbonate, and breaking up the salts thus formed by means of sulphuric acid.

Replacing Egg Yolk in Kid-Leather Tanning

In tanning leather attempts often have been made to replace the expensive and, frequently, adulterated yolk of egg, which has heretofore been indispensable for tanning kid leather. Eitner proposed, instead of yolk of egg, the use of emulsions of albuminous substances, fats and oils, and Armand Müller-Jacobs proposed the use of oils treated with sulphuric acid. Both agents have been found not to be suitable substitutes for yolk of egg. The leather becomes hard, thin, had no "pull" and not the feeling of leather produced with yolk of egg.

The action of the oils recommended by Müller-Jacobs may be improved by adding a volatile substance which dissolves the oil, for example a volatile hydro-carbon, acetic ester, or the like. However, with such substances the effect of yolk of egg was not obtained.

Otto Rohm of Darmstadt, Germany, in Patent No. 1,414,044, assigned to The Chemical Foundation Inc., states that the effect of yolk of egg is not only attained, but even exceeded, if the oils which have been treated with sulphuric acid, before being used, are freed from the soap present, and if the sulphuric acid-oil constituent is reduced in amount per unit volume by diluting with unaltered oil.

Oils that have been treated with a small amount of sulphuric acid, which are soluble in water, and whose solution does not thicken or slightly harden by air exposure, are excellent substances for greasing leather of all kinds and for oil tanning. Such substances can be obtained, if only that quantity of sulphuric acid is taken which gives after complete mixture of acid and oil a product that is easily soluble in water.

For example, this can be carried out with castor oil, if the treatment is effected with 0.5 to 1 per cent of sulphuric acid, whereas heretofore 10-25 per cent sulphuric acid has been employed. The sulphuric acid is poured slowly into the oil heated to about 40° C., which is continually stirred. After the mixture has been allowed to stand until cold and a thorough mixture is effected, the higher fatty acid constituents and other objectionable residues are removed by treatment with caustic soda.

Recovering Vanadium

The valuable properties due to high tensile strength and hardness, possessed by steels to which a small percentage of vanadium has been added, and the increasing variety of uses of this alloy have encouraged research in the procuring of vanadium. Alphonse Gildemeister, Paris, France, obtains pure vanadic anhydride from vanadium ores by the formation and separation of vanadium oxychloride.

Ores containing vanadium, either in the natural state as V_2O_5, more or less pure, or brought to this condition of maximum oxidation by an oxidizing roast, are first powdered, then exposed to the action of perfectly dry and concentrated chlorine in the presence of a suitable reducing agent while heated. This latter may be carbon, which is intimately mixed with the ore, or a reducing gas such as carbon monoxide. It has been found advantageous to use chlorine charged with a certain proportion of sulphur chloride vapor to form vanadium oxychloride ($VO\,Cl_3$) and sulphur dioxide.

The vapors of vanadium oxychloride (vanadyl trichloride), which are evolved at the temperature of the operation and which should be above the boiling point of this compound (about 126° C.), are then brought in contact with water in an absorbing device, such as a column. Under the action of the water a concentrated solution containing vanadyl trichloride is obtained, which after evaporation to dryness and subsequent oxidizing roast, yields very pure vanadic anhydride.

The metals associated with the vanadium in these ores, viz., lead, zinc, copper, iron, etc., are converted into chlorides with the production of heat which much facilitates the primary reaction; e.g., $2PbO+SCl_4=2PbCl_2+SO_2$.

The conversion of these metals into chlorides aids in their subsequent extraction and separation. The difference in volatility which exists between vanadyl trichloride (boiling point about 126° C.) and the chlorides of the heavy metals contained in the ores, renders a commercially complete separation possible. In view of the close separation which is claimed for this process, there results on the one hand a very pure vanadic anhydride and on the other, a residue containing only traces of vanadium.

Ingredients of a Glass to Separate Ultra-Violet from Visible Light Rays

To increase the absorptive power of glass for ultra-violet rays previous use has been made of cerium compounds, but in order to produce an effective absorption the amount of cerium required produced a yellow tint or decreased the transmission of visible light. William C. Taylor, of Corning Glass Works, (Patent No. 1,414,715) has produced a glass which has a strong absorption for ultra-violet light and which contains cerium dioxide, but possesses only a slight pink tint when in pieces of considerable thickness. He uses a glass containing substantial quantities of potash, the potash tending to reduce the yellow coloration due to cerium oxide when used in a soda glass, and by adding a small percentage of manganese dioxide.

The composition of a typical batch is as follows:

	Per cent.
SiO_2 (silica)	70.
K_2O (potash)	8.00
Na_2O (soda)	11.8
CaO (lime)	5.5
CeO_2 (cerium dioxide)	4.5
MnO_2 (manganese dioxide)	0.2

The glass resulting from the above batch is flesh tinted, and has a very high ultra-violet absorption, transmitting less than 1 per cent of wave lengths of 355 microns and less, and having a high transmission for the visible. The desired result is obtained by using betweet 3 and 6 per cent cerium dioxide, whereas the use of larger amounts results in too great an absorption of visible light and prevents the development of a pink tint by the manganese.

Canned Heat from Colloids

The preparation of a solid combustible material which may be conveniently transported and readily burned has been attended with several disadvantages, among which may be mentioned, non-permanency, liquefication when burning freely, exudation of the liquid component, formation of a crust after extinguishing, slowness in cooling when the flame is extinguished and not being readily relighted.

These difficulties are claimed to be overcome in a combustible material which leaves practically no residue and which is capable of modificaton by proper selection of materials to produce a luminous or non-luminous flame, which material has been made the subject of Patent No. 1,416,493, granted to Harry S. Mork, of Brookline, Mass., and Gustavus J. Esselen, Jr., of Swampscott, Mass., assignors to Arthur D. Little, Inc., and may be prepared in the following manner:

A suitable cellulose nitrate, as pyroxylin, is dissolved in a volatile combustible solvent or solvent mixture, as ethyl acetate, ether-alcohol mixtures, methyl acetate, mixtures consisting chiefly of ethyl alcohol, acetone or other ketones, etc. The solution is coagulated in a more or less comminuted or granular jellied condition, as distinguished from a single coherent mass, by means of an excess of a non-solvent liquid. The excess liquid is removed from the granules, which are then ready for the next step in the process.

A second solution of cellulose nitrate is prepared, to which is added a liquid non-solvent, in quantity sufficient to bring the solution almost, but not quite, to the point of coagulation. Into this second solution the jelly granules, or lumps, are introduced, and if the proportions of granules and the second solution are properly regulated the mixture will set to a solid mass without appreciable exudation of liquid.

For a material to be used as an illuminant, the mixture may contain 10-20 per cent benzene, gasoline or other coal tar or petroleum hydrocarbons. A non-luminous flame will be produced when the material is made up of suitable proportions of denatured alcohol and methyl alcohol in the solutions and coagulating liquid as well. The product may be colored and the odor may be modified and masked by the addition of small quantities of odoriferous substances.

Coumarone Resin

Coumarone resin is the name given to the product obtained by the polymerization of coumarone and indene contained in solvent naphtha or crude coal tar naphtha and in certain benzols. These bodies are found mainly in the fraction distilling between 160-180° C. This fraction is treated with a polymerizing agent such as aluminum chloride or 66° Bé. sulphuric acid. The acid, which is preferable, is added in the proportion of about one per cent, calculated on the total amount of the fraction of naphtha used.

The acid is added slowly under constant stirring and, owing to the bulk of the solvent material present, only slight, if any, cooling is required. The reaction or polymerization is relatively rapid. The resinous body which forms goes largely into solution in the naphtha, although a certain amount may become sulphonated to a tar or sludge and be found in the sulphuric acid residue which settles to the bottom. The acid sludge is drawn off. It is sometimes necessary to settle for several hours to effect good separation.

The naphtha solution of the resin is washed to remove traces of acid and is then steam distilled, whereupon the residue of crude resinous material, usually plastic or soft and pasty, is transferred to a vacuum still where it is distilled under a vacuum of 29 in. until the desired melting point is attained. Sometimes it is necessary to distill more than one-half the weight of crude resin before a hard product is secured. The distillate is a heavy viscous liquid, practically unsaponifiable and quite largely saturated.

Detailed operating procedure is given as follows by Louis Rabinowitz (Pat. No. 1,416,062): 1,000 parts of solvent naphtha are treated with 10 parts of 66° Bé. sulphuric acid, the acid being added in a thin stream under constant agitation. After one-half hour the acid is drawn off and the naphtha is washed with a five per cent solution of alkali. The mixture is allowed to settle, the alkali solution is drawn off and the solvent naphtha is distilled with superheated steam until the residue is freed therefrom. The thick viscous resin left behind is then hardened by distillation under a vacuum of 29 inches until the thermometer reads around 180° C. At this point the resin in the vessel is sufficiently hard to be used in the arts. If a harder resin is desired, the distillation is carried on further. The liquid material obtained by distillation of a particular sample of the soft resin at 180° C., under a high vacuum of about 29 inches, possessed an iodine number of 24, while the resinous material remaining behind had an iodine number of 47. The viscous resin mass may be hardened by distillation in steam at about atmospheric pressure, but the product is liable to be darker colored.

If a substantially lower degree of vacuum than 29 inches is employed, and a correspondingly higher temperature, the hard resin produced may be somewhat darker (probably due to some decomposition). By reasonably careful work, and when using a vacuum approaching 29 inches, products having iodine numbers below 50 may be made. Highly useful products can be made having iodine numbers between 46 and 50.

It is advisable in the distillation step, not to use a temperature over 200° C., or at most 200° C., since at higher temperatures considerable decomposition may occur, and the value of the product lowered.

Improvement in Sour Milk Beverages

Milk, skim milk, whey and meat broths, etc., are used in making cultures of *Bacillus bulgaricus,* including both the *Bacillus bulgaricus,* type A, also known as *Streptobacillus lebenis,* and the *Bacillus bulgaricus,* type B, also known as *Kernchen bacillus,* or *Bacillus boas appler.* In place of these, which are all objectionable, owing to the more or less insipid and nauseating character of the product, Joseph C. Richards, of New York City (Pat. No. 1,417,412), substitutes juices of the various fruits, such as pine apples, prunes, apples, oranges, lemons, the various berries, etc.

Mr. Richards adds the desired lactic acid ferment, such as *Bacillus bulgaricus* obtained from any available source, to any desired sterilized fruit juice. Fermentation or incubation is then allowed to proceed at a suitable temperature, say 180° F., until a desired amount of lactic acid and lactic acid microorganisms has been produced, when the liquid is cooled and is ready to be bottled, and is ready for use. If the lactic acid fermentation in any case is retarded or prevented by the presence of acid in the fruit juice the latter is neutralized to a sufficient extent by the addition of a neutralizing agent such as sodium, carbonate, or, preferably, an insoluble carbonate, such as calcium or magnesium carbonate. The neutralization may be effected previously or simultaneously with the fermentation.

The fruit juices treated may be selected with reference to certain desired properties, such as pine apple juice, on account of its peptonizing property, prune juice on account of its mildly laxative effect., etc., or fruit juices may be neutralized with magnesia and incubated to produce a mild laxative.

In place of the separated fruit juice, jellies may be used and also fruit pulp in any form carrying juice, such as jams, and may be subjected to the lactic acid fermentation and used as a hygienic food, or a portion of a certain amount of juice or pulp may be subjected to lactic acid fermentation and the untreated portion subsequently added. Likewise a certain amount of cane sugar, glucose or milk sugar may be added to the juice or pulp, previous to the fermentation.

When jellies or jams are treated they may be subjected to as high a heat as it is feasible to use during the incubation or fermentation, say 120° F., whereby the material treated will become much softened or perfectly liquefied. When the fruit juice, subjected to lactic acid fermentation, is intended to be used as a medicine it may be prepared so as to attain the same strength as the skim milk, whey, or beef broth preparations now in use. The liquid treated may also be evaporated, preferably in vacuo, and the finished product dispensed in a dry state.

Anthraquinone Manufacture

Anthraquinone is commonly produced by the oxidation of anthracene in an extremely fine state of division by means of chromic acid. In this process the reduction of the anthracene to the fine state of division is difficult and expensive, and further the chromic acid subsequently used for oxidation is a costly re agent. A process for the manufacture of anthraquinone which will be free from the objectionable features of the processes employed at present is the subject of Pat. No. 1,417.367, dedicated to the public, by Courtney Conover and Harry D. Gibbs of the Bureau of Chemistry, Department of Agriculture.

The invention consists in the production of anthraquinone from anthracene by heating the anthracene until it passes into the vapor phase, mixing this anthracene vapor with an oxygen-containing gas mixture, forcing this mixture of gases into close contact with finely divided oxides of vanadium, heated to a temperature ranging from 250° C. to 650° C., under which treatment the anthracene is partially oxidized to form anthraquinone, the basis of the vat dyes in whose manufacture Amer- [illegible]

The practical operation of the process is as follows: Anthracene is melted and is caused to flow continuously at a measured rate into a heated chamber where it is volatilized. This vapor of anthracene is then mixed with air in excess of the proportion theoretically required to oxidize anthracene to anthraquinone. The mixture of air and anthracene vapor is passed into a reaction chamber maintained at a temperature ranging from [illegible] to [illegible] C., the preferred temperature being [illegible] C. In this chamber the gas mixture is forced into close contact with finely divided [illegible] in the form of fine powder. This powder is supported on trays of a porous material where, by mechanical means, the current of mixed gases is forced through it. The gases are kept under pressure only sufficient to cause them to flow continuously through the reaction chamber. The product of the reaction, together with unchanged anthracene, is condensed and the anthraquinone is separated from the unchanged anthracene and other substances, by any well known means.

The process as above described may be varied in many ways and yet will produce anthraquinone. Thus, oxygen may be substituted wholly or in part for air, or air may be mixed with a gas which is relatively inert under the conditions obtaining in the process. The oxides of vanadium may be mixed with or combined with other substances, such as other metallic oxides, or with asbestos, pumice stone, or other materials. The gas mixture may be brought in contact with or forced through the catalyst in many different ways. The proportion of anthracene vapor to the oxygen-containing gas mixture may be varied within wide limits. Materials containing anthracene, together with the substances commonly associated with it may be used instead of pure anthracene. And the reaction products may be separated by various well-known means.

Dry Process Manufacture of Antimony Colors

Paul Chaillaux, a French engineer, has been granted Patent No. 1,417,033 for a dry process of making antimony colors, viz., gold-colored antimony sulphide (Sb_2S_5) and the crimson-colored sulphide. The process consists in melting in a closed vessel natural sulphide of antimony, stibnite, Sb_2S_3, by raising it to a suitable temperature, and then passing into the mass a current of air.

According to the temperature at which the operation is carried out, the product obtained, having the formula Sb_2S_5, has a golden coloration (gold-colored sulphide of antimony) or a crimson coloration (vermilion of antimony). The reaction is as follows: $2Sb_2S_3+2O=Sb_2S_5+2Sb+SO_2$. The gold-colored sulphides and the vermilions of antimony are produced in the state of powder and are collected in a settling chamber that allows only the gas given off in the reaction to escape. The sulphurous acid obtained by the above reaction may be used for several purposes as, for instance, the production of sulphites or of sulphuric acid.

Hydrogen-Peroxide-Sulphur Dioxide Bleach

Processes for bleaching with sulphur dioxide SO_2, have been known for many years, but it has been troublesome to eliminate the last traces of SO_2 in the product bleached. The Federal and State pure food laws limit the SO_2 content in foods, and it is therefore highly desirable to use a process which can remove entirely or decrease the amount of such SO_2 without damaging the food.

Irving Hochstadter, Far Rockaway, N. Y., has devised a process (Pat. No. 1,412,513) wherein hydrogen peroxide, H_2O_2, is added in amounts sufficient not only to oxidize the SO_2, but also itself to bleach the food, as he shows in the specific example of gelatine.

Gelatine which has been bleached with SO_2 may be further treated by hydrogen peroxide (H_2O_2) whereby not only additive effects of both bleaching agents are obtained, but also a combined effect which seems to be due to the bleaching action of the peroxide on substances ordinarily not susceptible to bleaching action by SO_2 or H_2O_2 but which are conditioned by the treatment with SO_2 so that they can be bleached by the subsequent treatment with the peroxide. The mere additive effect of the SO_2 and H_2O_2 treatment secures a better bleaching of the gelatine than by the action of either agent alone since one is reducing and the other oxidizing in its action. It is advisable to add from 2 to 4 per cent of ammonium hydroxide (NH_4OH) to accelerate the bleaching process with H_2O_2, and in case there should be any acidity in the product this can be neutralized with ammonium hydroxide. The treatment with H_2O_2 is carried out at a temperature of about 140° to 150° F. As a result of this treatment the sulphur dioxide present is entirely eliminated or reduced to the smallest possible amount, which would not be more than a trace.

In the bleaching of cherries, SO_2 may be added either uncombined as a gas or combined as a solution of sulphurous acid or of a sulphite such as sodium sulphite, which may be used in the cold or with the application of a little heat, and this treatment may be continued from one to 24 hours, according to circumstances. The SO_2 remaining is then washed out with water as much as possible, and there will be left an amount of SO_2 ranging from mere traces to five to six thousand parts per million. The cherries are then treated with H_2O_2 in the form of a 3 to 4 per cent solution in an amount sufficient to oxidize the SO_2 to H_2SO_4 or its compounds and also further to bleach the cherries.

The sulphuric acid H_2SO_4 and compounds formed may be then removed by washing treatment with an alkali to neutralize the acid or both.

A large number of other foods may be similarly treated such as fruit products, syrups, nuts, potatoes, apples, cereals, and in fact any kind of food susceptible to such treatment. The treatment of fruit products by this method is particularly desirable since a bleaching operation is generally necessary and must be thorough in order to make the goods marketable. Any H_2O_2 which remains in the foods does no harm since it breaks up to form water and oxygen gas very rapidly.

Personal Items

Dr. F. J. Metzger has been elected vice-president in charge of research and development of the Air Reduction Co.

* * *

James B. McNair, chemist with the Bureau of Internal Revenue, has been transferred from Washington, D. C., to Chicago.

* * *

Elbert A. Wilson has resigned as director, pyralin research laboratory, E. I. du Pont de Nemours & Co., to engage in consulting practice.

* * *

Francis R. Glenner is in charge of the chemical sales division of the Lindsay Light Co. of Chicago, at its New York office, 91 Chambers St.

* * *

C. R. Downs, formerly chief chemist, research laboratory, The Barrett Co., Edgewater, N. J., is now at the Buffalo plant, National Aniline & Chemical Co.

* * *

Dr. G. A. Menge has resigned from the technical staff of Libby, McNeill & Libby to engage in consulting chemical practice at 111 W. Monroe St., Chicago.

* * *

Harry M. Wey has been appointed manager of the Chicago district of the Pittsburgh Testing Laboratory, with office at 1560 Monadnock Block, Chicago, Ills.

* * *

Joseph C. Keller, formerly with the Apex Color Works, New York City, is now on the sales staff of the Smith Chemical & Color Co., 257 Water St., New York.

* * *

Everett W. Boughton formerly technical supervisor, Everett works, E. I. duPont de Nemours & Co., is now sales engineer, New Jersey Zinc Co., 160 Front Street, New York.

* * *

Michael Krieger, formerly secretary-treasurer United Chemical Products Co., Los Angeles, Cal., now dissolved, has taken over its business as Krieger Color & Chemical Co., of that city.

* * *

Dr. John S. Bates, president, Canadian Institute of Chemistry, is a Columbia University man, having received there his chemical engineering degree in 1913 and his doctor's degree in 1914.

* * *

Prof. Charles H. Warren, a Yale man on the staff of the Massachusetts Institute of Technology, has been selected to succeed Russell H. Chittenden as director of Sheffield Scientific School of Yale University.

* * *

Prof. E. W. Washburn, head, department of ceramic engineering, University of Illinois, will succeed Dr. Frederick G. Cottrell as chairman, division of chemistry and chemical technology, National Research Council.

* * *

Julian F. Smith, formerly at the Buffalo works of the National Aniline & Chemical Co., on the completion of his doctorate at the University of Chicago, will go with the Commercial Solvents Corp., Terre Haute, Ind.

* * *

William H. Nichols, chairman, board of directors, Allied Chemical & Dye Corp., has been made an honorary member of Phi Beta Kappa fraternity. Dr. Nichols is an alumnus of New York University of the class of 1870.

E. J. Lowry, formerly chemist and metallurgist, Oliver Chilled Plow Works, South Bend, Ind., has become identified with Hickman, Williams & Co., 120 Broadway, New York, pig iron brokers, as a service engineer.

* * *

G. W. Belden, for the past five years purchasing agent Spencer, Kellogg & Sons, Inc., Buffalo, N. Y., has engaged in independent business in that city as G. W. Belden Co., brokers in animal and vegetable fats and oils.

* * *

Dr. J. W. Turrentine is serving as consulting chemist to the purchasers of the experimental kelp-potash plant of the Bureau of Soils, Summerland, Calif., in virtue of a furlough from the Department of Agriculture until October 1.

* * *

G. D. Van Arsdale, formerly in partnership with L. D. Huntoon in consulting chemical and metallurgical practice, is now engaged alone as consulting chemist at 1011 So. Figueron street, Los Angeles, Cal. L. D. Huntoon is at 115 Broadway, New York.

* * *

Alfred C. Bedford, chairman, board of directors, Standard Oil Company of N. J., was the recipient of the honorary degree of Doctor of Laws at the commencement exercises of the University of Pittsburgh and the Mellon Institute of Industrial Research.

* * *

C. M. Williamson has resigned as New York sales manager U. S. Graphite Co. to assume the same duties with the International Carbon Products Co., 230 West 13th street, New York. This company produces flake graphite from Texas deposits which are the only domestic deposits being worked at the present time.

* * *

C. F. Carrier, Jr., formerly manager of the Charleston, W. Va., plant of the Warner-Klipstein Co., has the same position with the recently organized Carrier Chemical Co. of Charleston, W. Va., which will manufacture pharmaceuticals to be sold exclusively by McKesson & Robbins, New York City.

* * *

Dr. Colin G. Fink has been appointed lecturer in electrochemistry and will have charge of that division of the Department of Chemical Engineering, Columbia University, beginning July 1. He will continue his services as secretary of the American Electrochemical Society, office facilities having been arranged at Columbia for this.

* * *

Elmer O. Fippin, secretary and general manager National Lime Association, has resigned to organize the National Agricultural Consultant's Bureau, Washington, D. C. He is succeeded by W. R. Phillips, Pennsylvania State College 1906, who has wide experience in sales engineering. During the war, he served as civilian expert on industrial production in the Ordnance Department.

* * *

Dr. Richard C. Tolman has resigned as director of the Fixed Nitrogen Research Laboratory of the Department of Agriculture to accept the professorship of physical chemistry, California Institute of Technology, Pasadena. He is succeeded by Dr. Frederick G. Cottrell, who, since relinquishing his position as director Bureau of Mines, has been head, division of chemistry and chemical technology, National Research Council.

Industrial Notes

Borax will be refined at Rochester, Pa., in the plant of the old National Glass Co. by the American Borax Co., which has acquired the property.

* * *

The Viscose Co., Marcus Hook, Pa., is enlarging its Lewiston, Pa., plant and entering upon a housing development which will comprise 200 homes for its operatives.

* * *

Atlas Oil Co., Monroe, La., will build a new carbon-black plant, estimated to cost in excess of $200,000, including machinery. A gasoline extraction works also will be built.

* * *

By-Products Recoveries, Inc., 328 Seventh avenue, New York, has contracted to furnish the ore-roasting plant of the Pyrites Co., Ltd., Wilmington, Del., with dust-collecting equipment.

* * *

Lignite Industries Corp., St. Paul, Minn., a Nevada corporation of $10,000,000 capitalization, will build lignite distillation plants at Greenville, Fort Worth, Dallas and Houston, Texas.

* * *

Dr. M. C. Whittaker, operating vice-president, U. S. Industrial Alcohol Co., announces that by July 1 his company will be in a position to contract for the sale and delivery of 1,000,000 gallons of alcogas per month.

* * *

The National Sulphur Co., Bayonne, N. J., has under construction at Akron, Ohio, a new plant estimated to cost $400,000 and requiring 350 workmen. Operations at the Bayonne plant at Constable Hook will be transferred to Akron.

* * *

Textile manufacture on the Pacific coast will be initiated by the Imperial Cotton Mills Co., which will install in the buildings of the former Malthi brewery of Los Angeles, Calif., 20,000 spindles and employ 600-800 operatives.

* * *

Buffalo Foundry & Machine Co., Buffalo, N. Y., has purchased the plant and business of W. A. Case & Son Mfg. Co., coppersmiths, which acquisition will enable them more efficiently to meet all requirements in copper equipment work.

* * *

The Anaconda Copper Co., 25 Broadway, New York, will build a new lead and zinc plant at Akron, Ohio, estimated to cost about $1,000,000, with machinery, and will be operated by its subsidiary organization, the International Lead Co.

* * *

Valley Chemical Co., John P. Thomy, president, St. Louis, Mo., has taken over the plant and other assets of the Collinsville Zinc Co., and will increase its facilities for producing lithopone. Mr. Thomy also is president of the National Pigment & Chemical Co., producing barytes.

* * *

Additional chemical industries recently located at Nitro embrace the Carrier Chemical Co., M. T. Davis, Jr., president, which will turn out a line of chemicals, and the Charleston Paper Mfg. Co., which has acquired 10 acres of land with buildings which will be remodeled and equipped at a cost of $100,000.

The Pickering Chemical Corp., 1 Madison Ave., New York, Oscar W. Pickering, president, will engage in the manufacture of nitro-cellulose products at Nitro, W. Va., utilizing in its plant facilities provided for munitions manufacture. Mr. Pickering formerly was with the Fibreloid Corp. and the Visciloid Co., and later with the du Pont organization.

* * *

Common stock of the International Carbon Corp., organized to acquire control of the Darco Corp. and to combine under one management the manufacture and sale of decolorizing carbon, is being marketed to the extent of 110,000 shares at $11. Operation of the manufacturing plants of the Darco Corp. is now under the supervision of the Atlas Powder Company.

* * *

Our sumptuary laws are encouraging Canadian developments, particularly in the province of Quebec, which may make Montreal the "Milwaukee" of Canada. Following upon a recent announcement of construction of a brewery at Valley Field comes the incorporation at Ottawa of the Carling Export Brewing and Malting Co., Ltd., capital $1,000,000, with chief place of business at Montreal.

* * *

The Anaconda Copper Mining Co., through its subsidiaries which produce copper and zinc shingles, has contracted with the Glidden Co. whereby the latter acquires the exclusive sales rights in these products throughout the United States. The Glidden Co. also has arranged through the Anaconda Lead Products Co. for the exclusive manufacturing rights to Anaconda lead in oil. This new paint pigment is made by the electrolytic process.

* * *

Borax will be refined at Rochester, Pa., in the plant of the old National Glass Co. by the American Borax Co., which has acquired the property. The American Borax Co., E. L. Dawes, president, is a subsidiary of the Standard Sanitary Mfg. Co., Bessemer Bldg., Pittsburgh, Pa. The Austin Co., Cleveland, Ohio, has a contract for the construction of a plant addition to cost $100,000. Besides remodeling existing structures a new power plant will be built.

* * *

C. Wilbur Miller, president, in his 1921 report of the Davison Chemical Co. and the Davison Sulphur and Phosphate Co., mitigates the impression produced by the statement of a deficit for 1921 of $411,938, with no dividends, as against a surplus of $822,602 for 1920, including dividends of $422,602, in the following words: "The enormous losses shown by other companies explain why the earnings statement is not more satisfactory, but we feel confident of our future position when we consider we have weathered the storm without these large losses and have our surplus account practically intact, with inventories and operating costs back to normal."

Of silica gel, produced by the subsidiary, Silica Gel Corp., President Miller says that is not a product manufactured, sold and consumed. There are three types of apparatus which cover its many uses, one for cleaning liquids, one for absorbing gases and drying air, and one for refrigeration. The corporation has been offered some attractive contracts and more important ones are now in negotiation. The Silica Gel Corporation was organized in July, 1921; of its stock 49 per cent is owned by the Davison Chemical Co. and 51 per cent by the patentees.

CHEMICAL AGE

A CONSOLIDATION of THE CHEMICAL ENGINEER and CHEMICAL AGE

LLOYD LAMBORN, *Editor*

VOLUME 30 NEW YORK, JULY, 1922 NUMBER 7

Research from the Business Man's Standpoint

By Edward P. Hyde

Director of Research, National Lamp Works of General Electric Company

I AM reminded of the introduction of a well known American who returned to his alma mater to address the scientific society of the university. The chairman recalled that when this alumnus was a student at the university he studied both physics and chemistry. The physicists thought he was a chemist, and the chemists were equally convinced that he was a physicist.

Though no one has been unkind enough to make such a suggestion openly, I always feel, when among my scientific friends, that they look upon me as an engineer or as one tainted with commercialism, and when I am among business associates and acquaintances I am frequently subjected to the indignity of being addressed as "Professor." This is all by way of explanation so that you may appreciate the viewpoint from which I look out upon the subject, and thereby be better qualified to evaluate my opinions. Further, I wish to disclaim at the outset that any contumacious remarks which I may be led to make, have any reference or application to those business executives associated with the particular industrial corporation by which I am employed, or to those particular scientific men with whom I have the pleasure of laboring as a colleague. I have enjoyed the opportunity of wider observation, and the opinions expressed reflect the general conclusions from this broader experience.*

EDWARD P. HYDE
Director of Research, National Lamp Works of General Electric Company.

Emancipation of Research

The spirit of Research, formerly the cherished esoteric possession of the University, has long since been emancipated. In recent years the idea has become almost vulgar by cheap imitations. These latter have no part, however, in our present discussion. On the other hand a new era of civilization has resulted from the judicious application of scientific research in industry. In some industries the idea of research has been utilized much more fully than in others. This is to be expected. Obviously the manufacturer of internal combustion engines might expect larger dividends from research than the manufacturer of kitchen utensils, though I am not sure that the latter might not well make some investment to this end.

Again, the imagination of the business executive is an important determinant in the establishment of a research laboratory in any particular industrial company. Finally, the stress of competition in competitive businesses, and the appreciation and acceptance of the responsibility of service, particularly in industrial enterprises of a monopolistic nature, are potent factors in determining the quality and quantity of research activities.

At present I think it is fair to say that industrial research, at least in the United States, is out of balance. Some industrial corporations which might annually spend millions in research are operating on a mere pittance for this purpose, while other concerns have established expensive laboratories and provided elaborate facilities for research. I do not know of any industrial corporation which is expending in the aggregate too much money on research work, but it is questionable whether the work is always most wisely organized and the money most judiciously expended.

How Much Money Should Be Spent on Research?

How much money should an industrial corporation expend annually for research work? Or, more fundamentally, how can an industrial corporation arrive at a fair expenditure for research? These are difficult questions to answer. No one has made a statistical investigation of the problem. Even if the facilities for such a study were available it would be difficult to analyze the results and arrive at a correct answer.

---

*An address presented before the Engineering Division of the National Research Council, February 14, 1922.

The benefits of research are ofttimes intangible and cannot be traced to their proper source, and then there is the large element of personality which constantly confuses the problem. And yet this is the problem with which a progressive business executive finds himself confronted when the idea of research has been sold to him. He must make the decision, and he has nothing in his own experience to guide him.

Classification of Research

Perhaps it is well to approach the problem in a slightly different way. Let us seek to classify the various kinds of research work which might be undertaken, and to evaluate in a general way the returns that might accrue. There have grown up in the United States five different kinds of research activity in industry which might be defined as (1, 2) fundamental research in both pure and applied science, (3) development work, or research directed to the solution of manufacturing troubles, and to minor improvements in the established procedure of manufacture, (4) research directed to the uses of the manufactured product, and (5) research and testing in regard to the raw materials and the finished product.

These various kinds of research in American industry have been tabulated by A. P. M. Fleming as the results of a survey of industrial research in this country and published as a monograph of the Department of Scientific and Industrial Research of the British Government. The classification contained in this monograph gives the five classes of research outlined above, though in a somewhat different order, and I shall, therefore, use it as a basis for the present discussion, as follows:

I. Research applied to the elimination of manufacturing troubles.

II. Research having some new and specific commercial object.

III. Researches in pure science with no specific commercial application in view.

IV. Research applied to public service.

V. Research for the purpose of establishing standard methods of testing and standard specifications connected with the purchase of raw materials.

I—Research to Improve Manufacturing Methods

This class of research would be undertaken in what might be called a Works Laboratory. In addition to the elimination of manufacturing troubles it would probably be concerned with minor modifications and improvements in the product. This is one of the most common types of laboratories classed as research laboratories in industrial corporations. The Works Laboratory and that listed above under Class V, which might be described as a Control Laboratory, represent by far the largest number of research activities in the American industries. This type of work is probably the most apparently necessary and most easily appreciated. It is work for men who have been trained in research, but who also have had the opportunity of large practical experience in the particular manufacturing processes involved. It is work that should be performed in close cooperation with the factory, and, probably, for its greatest value, in close physical proximity to it.

The returns from the Works Laboratory may approximately be evaluated, especially in so far as it contributes modifications in process or machinery for manufacturing the product made in the company's factories. Obviously, if an improvement in process or the design of a new machine reduces the integral cost of manufacture per year by a given amount, the expenditure to accomplish this saving cannot profitably be more per year than the amount of the saving over a larger number of years. It is questionable whether the expenditure can be justified if the saving in one year, or at most in two or three years, does not exceed the cost of development.

II—Research With a Specific Commercial Object

Closely allied in thought with the research done in the Works Laboratory is the class of research contemplated under Class II. It might be called fundamental industrial research, and the laboratory engaged in it as the Fundamental Industrial Research Laboratory. It supplements the Works Laboratory; it is one step further back, or one might equally well say, one step further in front of manufacturing practice. The Works Laboratory is concerned with factory problems of the established product of the factory, and perhaps with minor improvements in process or materials. The Fundamental Industrial Research Laboratory is primarily devoted to the development of some entirely new product of manufacture. The invention of the gas-filled electric lamp is an illustration of the results of research of this type.

Obviously the amount of effort and the amount of money that can justifiably be devoted to research work of this kind will depend, in the first instance, on the saturation of the field. By this I mean that it evidently would be unwise to make any large expenditures to improve the efficiency of transformers, which already have an efficiency of almost 100 per cent.; whereas, on the other hand, it would seem that an entirely different approach should be made in the matter of expenditures for the further improvement of illuminants which have an absolute efficiency of only a few per cent.

But there is a second consideration. Even though the field for new inventions may not be saturated, there still remains the large element of chance. One can with certainty undertake to improve or develop some established commodity or processes of manufacture by assiduity and reasonable intelligence, but one can never be sure of making a strike in the way of some new, revolutionary discovery of commercial value. One might undertake to make slight improvements in the mining of ore from a gold mine, with confidence of some success, but he would be gambling if he hazarded much in the search for a new and profitable mine.

The establishment of a laboratory for Fundamental Industrial Research is in the nature of a gamble, but for those technical industries in which saturation has not been reached it is a gamble with the odds largely in favor of the business executive of imagination and foresight who makes the gamble. In one way the industrial corporation cannot lose, for even though no revolutionary and highly profitable discovery or invention is accomplished, knowledge of a valuable character, even though negative as to results, will have been gained if the laboratory has been administered wisely in a scientific way.

There are those who believe that revolutionary, or perhaps I had better say, distinctive discoveries or inventions are largely individualistic, and may be made quite as likely by individual workers outside a corporation laboratory as by those within it. They argue, therefore, that the industrial corporation is, on the average, as well or better off if it undertakes no fundamental industrial research on its own account, but seeks to secure by purchase or otherwise the benefits of such advances as they become available.

I do not believe this view to be justified by experience, or right in its premises. The well organized laboratories for fundamental industrial research of our large corporations have certainly much more than paid their way in specific output. Moreover, there is no doubt in my own mind that, apart from their direct return, they are pregnant sources of inspiration and suggestion to those individual workers outside them.

III—Pure Science Research

Closely allied with this fundamental research of a direct industrial nature, is that other kind of fundamental research which has no immediate industrial object in view, and hence is called pure science research. This is the third kind referred to in the classification. It is not the place here to distinguish the various kinds of pure science research. I have already expressed my view on this subject elsewhere.*

The more progressive industrial corporations will recognize the value in deferred returns in establishing intensive research work in those branches of science on which the industry rests. In some branches of industry, for example, wireless telephony, the applications in industry are on the heels of the advances of pure science, but even in those branches of industry where this condition does not obtain, it is advantageous to stimulate and encourage the development of the fields of pure science out of which industrial application of the future will come.

There is no guide to be suggested for the expenditures to this end. A small fixed sum year by year may wisely be devoted to research work of this kind, particularly by those industrial corporations which are in the nature of a monopoly, and which on the one hand have an obligation to the public, and on the other hand an obligation to themselves to anticipate displacement by some new and progressive concern. Nela Research Laboratory of Pure Science, originally The Physical Laboratory of the National Electric Lamp Association, was perhaps the first organized effort in this direction, though now many industrial corporations make large annual expenditures for this class of work.

IV—Research Applied to Public Service

Research applied to public service, i. e., Class IV, is now a recognized function of large industrial corporations as well as of public utility companies. To study the needs of the consumer in a research way, and to investigate the fields of use of a manufactured product is almost, if not quite, as important a field of research by an industry as that which pertains to the manufacturing end. Indeed such research work is quite likely to react to the development of new manufactured products, for industrial success depends upon the marketing of a commodity best suited to meet the needs of the consumer. A steel manufacturer who gave scant attention to the particular demands of the designing engineers, but insisted upon restricting his product to some obsolete form of beam or rail would have small chance of success against a more progressive competitor even though his manufactured product showed a higher degree of excellence.

V—Research in Standardization of Procedures and Products

The last class of research referred to already has been described as the function of a Control Laboratory. It is ofttimes necessary to test raw materials and to set up technical specifications for their purchase. It is frequently desirable, also, particularly in the case of those industrial corporations which operate many factories, to standardize the manufacturing methods and to formulate precise specifications promulgated through standardizing notices. Finally it may be advisable to exercise close control over the manufactured product by elaborate checks and tests. All these functions should perhaps be consolidated in a single laboratory. Much of the work might properly be considered as foreign to research, but in almost every function which such a laboratory would perform, research would play a part, and the spirit of research might wisely prevail.

How Much Money for Research?

No definite answer has been presented to the question of the amount which might reasonably be expended by an industrial company for research. It is evident that it is a function of many variables, viz., the technical nature of the business, the degree of saturation with respect to possible improvement, the advisability and value of stimulating interest and activity in the fundamental sciences underlying the business, and the possibilities of investigation as relate to uses of the product and consumer needs.

Back of all is a large human factor. If intelligently organized and administered a large expenditure might yield highly profitable results; if unwisely planned a research laboratory on even a small scale might not carry itself; it might even create an expensive confusion. The responsibility rests to a large extent with the one chosen to direct the research, but it also rests, perhaps to a greater degree, with the business executive and the foresight and judgment which he employs in initiating and organizing the research program.

Selling Research to Business

Selling the research idea to business is the task of research men. The business executive of imagination will be convinced by a broad-gauge presentation of the idea; the business man of lesser calibre needs to be shown specific possibilities of not too-distant profits.

The problem of selling research to the business man is at times a difficult one. If one undertakes to prove by the deductive method of reasoning that knowledge must precede practice, he may find himself involved in the time-worn sophism as to whether the hen or the egg can claim aboriginal priority. If he assumes to show by the statistical method that, for example, all modern electrical development traces its ancestry back to the equations of Clerk Maxwell and the brilliant experiments of Faraday and Henry he may find himself convinced in the end that in modern times everything new in industry really starts in the factory, and that the research men are useful only in showing why it happened after it was all over.

To be successful the salesman of research should be provided with a clear-cut, precise definition of the term *research*, for much of the difficulty lies in leading the business man around a circle of terminology. Secondly, he should be fore-armed with a carefully prepared statistical record of the part played by research, not only in furthering abstract knowledge, but in the accomplishment of industrial advancement. I would urge the importance of furnishing our research colporters with such material if they are to evangelize the industrial world.

---

*See Abstract of Paper presented before A. A. of Steel Treaters; *Chem. & Metall. Eng.*, Oct. 5, 1921; page 638.

A Plea for American Valuation

By Francis A. Adams

TARIFF legislation is divided into two parts: first, the schedules and the duties to be levied; second, the administrative feature which determines how the law shall be enforced. Under the present world conditions it is agreed to by every reasoning citizen of this country that some recognition must be given to the fact that our people have adopted a high standard of living and of working. We, as a nation, are spending more per capita for housing, education and living than any other. These circumstances necessitate that competition from abroad, present or prospective, must be controlled to some extent, or our basis of existence must undergo a downward revision.

The tariff schedules have been arrived at after long and careful consideration, and the hearing of both sides of the question. These schedules and the duty they carry will mean little or nothing unless the United States exercises the power to measure the value of goods by its own standards of cost. The change from foreign valuation to American valuation is necessitated by conditions arising from the World War.

The United States emerged from the four-year conflict as the great creditor nation; we have the only money that is based on an adequate metallic reserve of gold and, consequently, the dollar, and not the pound sterling or any other money, is the standard of value of the world today. To administer the tariff on foreign valuation is to invite commercial disaster to this country. One example will suffice. A duty of 40 per cent, ad valorem, on a china dinner set made in England at a cost of $20 would be $8; on a similar set made in France, at a cost of $16, the duty would be $6.40; on a Japanese set costing $10 the duty would be $4; on a set from Austria, costing $8, the duty would be $3.20. The American made set of similar quality costs $30.

The same situation is applicable to every manufactured product which the foreign maker seeks to sell in our markets, under alien production conditions that mean destruction of the American industry producing the competitive product. The chemical industry, created by war conditions and fostered in the hope that America may become independent and self-sufficient in the products that play so important a part in the activities of peace and war, stands on the brink of ruin if a consistent system for its protection is not applied.

It is manifest that if the duty is levied upon the foreign valuation of the various countries, the protective feature of the tariff is of no avail. The English set, coming from the country nearest us on costs, is $8 as compared with the $3.20 duty on Austrian made, the country of lowest costs. On the foreign valuation basis we impose on the countries that are struggling to maintain their standards of living the greatest duties, and on the low wage countries we permit their merchandise to come in at the lowest taxation. This is a commercial anomaly. We also withdraw the needed protection to an American industry and minimize our tariff revenue collections.

On the American valuation the results are equitable and effective. All countries importing to the United States would pay the same amount of duty. It would be 40 per cent of the cost of the American goods that cost $30 or $12 for English, French, Japanese or Austrian ware. There would be no guesswork as to values abroad. This would afford a measurable protection to the American pottery industry; it would make all foreign nations stand on an equal footing. And it would be productive of maximum revenue on all goods imported.

Every important nation in the world today is administering its tariff laws on the basis of domestic valuation except the United States. It is time that the people understood this question and ceased being befuddled by the erroneous statements of importers and bankers who have every apparent reason for wanting the United States to hobble itself with the defunct foreign valuation method of administering its tariff which died with the World War. The Senate bill is a straddle that seeks to shift the legislative function to the President. Let us have a genuine American tariff based on American valuation, and industry in our country will revive and survive.

Women in Pharmacy and the Demand For Analytical Chemists

This last half century has witnessed the advent of women into all the professions and most of the callings that are open to men, and they have proven conclusively that they are able to take their places in the field of labor with the male members of society.

There is no field that offers greater opportunities for women than pharmacy. The work is clean, pleasant, and agreeable, and one that a scientifically trained woman is well fitted to do. Women in pharmacy have long ago passed the experimental stage, as many of them are successfully conducting their own stores, and many others are ably doing the work of the dispensing laboratory. In fact, they have become so important in this work that they have their own section in the national association, known as the Woman's Section of the American Pharmaceutical Association.

Never has there been such a demand for skilled pharmacists, and never has the recompense been so great. There was a scarcity of pharmacists before we entered the war, and this has been increased rather than diminished. We have received many calls for lady pharmacists.

What is true in retail pharmacy is also true in analytical laboratories. There is a great demand for analytical chemists, food and drug analysts, bacteriologists, and public health workers. Women are competent to do all of this work if they have received the necessary scientific training. We had graduated many ladies who have acquitted themselves excellently in their profession. Ladies constitute over 10 per cent of our present student body. The Purdue School of Pharmacy offers splendid opportunities for ladies to secure a scientific training, and will gladly welcome any who wish to avail themselves of the unusual opportunities that pharmacy offers them.—*From Bulletin of Purdue University, Lafayette, Ind.*

The distribution of the 1922 fall season shade card of the Textile Color Card Association of the U. S. is followed by a new edition of "Dyer's Formulas," issued by the National Aniline & Chemical Co., 40 Rector St., New York, which contains recipes, prepared by its dye application laboratories, for the use of its dyes in the production of the seasonable shades on silk, cotton, wool and leather. This booklet has become an indispensable manual to practical dyers.

Vitamines: The Facts and the "Bunk"

A Discussion of Some Commercial Aspects of the Popularization of the Chemistry of Food Accessories.

By Hermann C. Lythgoe
Director, Division of Food and Drugs, Massachusetts Department of Public Health

I HAVE no desire or intention of critizing the scientific work which has resulted in the discovery of vitamines. I wish, however, to point out certain commercial abuses of these discoveries and the relation of these abuses to our food and drug laws and our "false advertising" law. Let us consider the vitamines historically, biologically and chemically, apart from the bunk.[1]

Vitamines Historically

As early as 1870 Kramer stated regarding scurvy: "If you can get green vegetables; if you can prepare a sufficient quantity of fresh antiscorbutic juices; if you have oranges, lemons, citrons, or their pulp and juice preserved with whey in cask, so that you can make a lemonade, or rather give to the quantity of three or four ounces of their juice in whey, you will, without other assistance cure this dreadful evil." In 1896, Hopkins, an Englishman, concluded that animals required something in their foods other than the common nutrients, and called these hypothetical substances "accessory food factors." In 1898, Eijkman, a Dutch chemist, succeeded in producing in fowls a disease called polyneuritis, which is substantially beriberi, by feeding polished rice and was able to cure the disease by feeding rice polishings. In 1907, Fraser and Stanton showed that an alcoholic extract of rice polishings contained the curative for beriberi.

Stepp, a German, discovered in 1909, that if bread and milk was extracted with alcohol-ether the residue was unsuitable for growth, and that the addition of purified fats did not supply the deficiency. He discovered that the addition of the substance left after the evaporation of the alcohol-ether extract was capable of promoting growth. In 1909 and 1910 Osborne and Mendel showed that in rat-feeding experiments, no matter how efficient the diet was, the rats refused to grow unless there was added to the diet a factor found in milk. They also discovered that the factor was found in two fractions, viz., in the fat, and in the fat- and protein-free milk, and that the absence of either fraction would prevent growth.

HERMANN C. LYTHGOE
Director, Division of Food and Drugs, Massachusetts Department of Public Health.

In 1911, Casimir Funk[2] obtained by chemical fractioning of extracts of rice polishings a crystalline substance, highly curative for the disease beriberi, and a year later obtained this substance from brewers' yeast. This substance contained nitrogen in its basic form, and, since it is essential to life, he gave it the name "vitamine." Subsequently it was discovered that the dietary essential was an impurity in the crystals, which has resulted in considerable discussion regarding the validity of the name "vitamine."

About the time that Funk published his findings and named the product, Suzuki, a Japanese, and his fellow workers Odake and Shimamura, isolated a curative substance from rice polishings which they called "oryzanin." Dietary studies made at the Wisconsin Agricultural Experiment Station, under suggestions from Prof. S. M. Babcock, showed that animals nourished by the same amount of proteins, fats and carbohydrates were not furnished with sufficient bodily needs in all cases. These experiments were reviewed and continued by McCollum, who, in 1912, announced the "unidentified dietary factor fat-soluble A" found in milk fat and egg fat.

Notwithstanding the fact that at least one of the vitamines is not an amine, and the evidence of the *amino* nature of another is far from satisfactory, the name "vitamine" is here to stay, and, at present, we believe there are at least three, viz., the fat-soluble A, the water-soluble B, and the antiscorbutic C, and, possibly, the anti-rachitic D, with indications that we have not yet reached the limit.[3] They are all of vegetable origin and their presence in animal foods, as in milk, depends upon the character of the food eaten by the animal. We know practically nothing of the chemical nature of these substances, except considerable of what they are not.

Vitamines Biologically

The testing of vitamines is done by time-consuming and, to some extent, unsatisfactory biological methods. Animals are fed upon diets otherwise sufficient, but deficient in the specific vitamine to be tested for. When the animal shows by lack of weight or other physiological abnormality that it is suffering from the dietary deficiency disease there is added to the diet the substance to be tested, and the animal recovers if the specific vitamine is present.

The study of vitamines is of primary importance to the dietitian, to the infant specialist, to the physician dealing with certain diseases, and to the food manufacturer, but its interest to the public is due to the mysterious nature of the substances. The human race has managed to survive for thousands of generations, depending upon its appetite in the selection of its food, and, except in certain instances of famine, etc., a knowledge of the vitamines would have had little or no beneficial effect upon the race, broadly speaking. Nature works in a horribly ruthless manner, but man always has been making more or less effort to improve conditions for the weak and downtrodden; consequently, the general average condition of the human race is somewhat inferior physically to that of the wild animals, and more care is necessary in selecting our diets.

---

[1] An address before the Northeastern Section of the American Chemical Society, Boston, Mass., April 14, 1922.

[2] See "Vitamines and the Future of Margarin Manufacture," by Dr. Casimir Funk, *Chemical Age*, May, 1922.

[3] Rivalry in vitamine research characterizes the rapid progress in biochemical knowledge. Dr. E. V. McCollum, of the School of Hygiene and Public Health, Johns Hopkins University, has announced, after three years' research in the study of rickets, the discovery of vitamine D essential to bone growth. Dr. Alfred F. Hess, of the College of Physicians and Surgeons, Columbia University, has indicated that sunlight may produce vitamines directly in the human blood, and that rickets may appear in children regardless of diet. Following upon the discovery of vitamines in pork, as announced in June CHEMICAL AGE by the U. S. Department of Agriculture, comes the report of the work done at Columbia University in confirmation of Explorer Stefansson's experience that fresh meat of any kind would prevent or cure scurvy. Dr. Casimir Funk, director, H. A. Metz Research Laboratory, the father of vitamine research and the author of the name, says that vitamine research barely has begun, and asserts the likely discovery of additional members of the vitamine family. He is engaged now in the study of evidence that pellagra is due to a diet deficiency in a vitamine as yet unisolated.—Editor, CHEMICAL AGE.

Vitamines Chemically

The articles of food most liable to contain no vitamines are purified chemicals, such as starch, sugar, vegetable oils, "purified" flour, etc. The articles of food containing all three vitamines simultaneously, the A, B, and C, include raw milk, liver, germinated grains, cabbage, tomatoes, beet roots, carrots, cauliflower, lettuce and spinach. Most other foods contain one or more vitamines, and it may be stated, as a general principle, that given a sufficiently miscellaneous assortment of foods to choose from there will be no dietary deficiency diseases.

Vitamine A is comparatively stable to heat alone, but in the presence of oxygen it is rapidly destroyed by heat. Hydrogenation destroys it, but acids and alkalis have but little effect.

Vitamine B in acid or neutral solutions is fairly stable to heat, but in alkaline solutions it can be quickly destroyed at 90° C.

Vitamine C is much more sensitive to heat and alkali than the others. Temperatures above 50° C. are more or less destructive according to the time factor. Cabbage cooked one hour at a temperature between 80° and 100° C. loses 90 per cent of its antiscorbutic properties.

Psychology of Medication

The belief in the supernatural is even now highly prevalent, and appeals to that belief usually bring results, other things being equal. The peculiarly mysterious properties of the vitamines have popularized them, and they have been swallowed hook, line, and sinker by the public. It is worthy of note that the same procedure ensued relative to electricity, radium and the Einstein theory. Thirty years ago electric belts, electric inner soles for shoes, electric batteries, etc., were quite commonly used for the mitigation of real and imaginary diseases, while thirty years after we accomplish better results with electric coffee pots and electric washing machines. Radium was not very popular as a general cure-all, possibly owing to the expense, and the Einstein theory is not adaptable. The vitamines, however, are so constituted that they can and are being sold at high prices to the incredulous, to mitigate mostly imaginary evils.

I believe that the continued sale of these products is doomed to failure for purely psychological reasons. A proprietary medicine, to be successful, must possess two prime attributes, viz., it must have a disagreeable taste or odor and, it must show immediate physiological results. The vitamines must of necessity fail in these attributes, unless, as in some instances, drugs are added, because they are tasteless and because the abundance of vitamines in our daily diets is such that preparations containing these agents would have no visible effect. These commercial preparations are essentially yeast or other vegetable concentrates; to some are added strychnine, phenolphthalein and organic iron compounds to secure the physiological results so necessary for the commercial success of a proprietary remedy.

Commercial Vitamine Publicity

No person takes more care in his advertising than the proprietary medicine man. He knows the laws, their limitations, the efficiency of their enforcement, and knows that outside of food and drug advertisements there is little or no systematic policing of false advertisements. He is, therefore, careful and the vitamine bunk shows practically 100 per cent efficiency in complying with the food, drug and advertising laws. Let us consider the bunk:

> Weigh Yourself—Then Take Vitamine Tablets—and watch the results. Thin, weak, run-down folks who wish to put on Good, Firm Flesh, etc., should try this wonderful nutritious product.

The advertisement shows a female figure tipping the scales at 95, with scrawny neck, ungainly figure, flabby tissues and sallow complexion. Facing her is the figure of a buxom female of 125 pounds, with clear skin, firm flesh, and well-rounded figure chock full of vitamines. The advertisement states:

> We do not claim, however, that vitamines will put flesh on everybody. Some people are naturally too thin and will probably remain so in spite of vitamines and everything else.

This advertisement advises obtaining your strychnine from other sources. Another advertisement of the same proprietary calls attention to a startling exposure, and, picturing a young lady in an abbreviated costume, truthfully states:

> Take one single substance from the blood of the beautiful, healthy, well-formed woman in this picture, and she will become weak, thin, emaciated like the thin, scrawny woman in the picture below, on three or even four big meals a day—put this magic-like substance back and she will quickly put on good, firm flesh and become rosy cheeked, strong and vigorous, even on two meals a day.

It again calls attention to the fact that the preparation does not always work, but neglects to add that our daily diets usually contain this one single substance so necessary for our continued existence.

A description of another product shows two female figures of different weight, appearance and dimensions, the inference being that vitamines did it. The directions are first to weigh and then measure yourself, then take two tablets with each meal and keep up the process until you are satisfied with your gain in weight and energy. Note the complete absence of the time factor. The gain in energy is insured by the addition of strychnine to the tablets.

Another advertisement of the same drug is similarly worded. Just above the picture of the young lady chock full of vitamines, pep and strychnine, are directions to take some tablets and watch the surprising results. Does this possibly refer to an overdose of strychnine? I hope not. There was one death in Massachusetts this year due to too many strychnine tablets in a child.

An advertisement referring to a yeast tablet contains one false statement. Referring to iron and vitamines it says: "Both of these elements are lacking in the average modern diet." They guarantee to "bring satisfactory results or your money back." The proviso covers a multitude of sins.

Certain definite measurements of a young lady are given in another advertisement. In twenty two days she increases in weight 10 per cent; chest, 8.6 per cent; calf, 8.3 per cent; arm, 5.3 per cent; neck, 4.1 per cent. There is still room for improvement. She will be heavier when she reaches the age of forty.

An advertisement headed *"Vitamines and Calories,"* designed by a man who recognizes the bunk and takes the bull by the horns says:

> The discovery and scientific application of the elementary units of body building foods are wonderful helps in rebuilding the ailing. The average person who has robust health and strength does not worry about vitamines and calories; he simply uses —— —— appetizing and high in food value.

Vitamines and Class Legislation

The discovery of vitamine A has given a tremendous stimulus to advertisements concerning the dairy interests. The per capitum consumption of milk and butter has decreased materially since 1916, but is now increasing, due to reductions in price rather than to publicity. The general public prefers butter to oleo, but when the prices go too high, the consumption of oleo always increases, and with falling prices it decreases. With increasing milk prices the consumption is curtailed, and with decreasing prices the consumption is increased. The advertising of milk as a food with reference to its vitamine-content is in general in accordance with the facts, except that no mention is made of low or no vitamine milk, which is something more than a scientific curiosity.

Kennedy and Dutcher state in "The Journal of Biological Chemistry," February, 1922, page 538:

> 1. The presence of vitamines A and B in cow's milk is dependent upon their occurrence in the ration.
> 2. Stall-fed cows will produce a milk rich in vitamines, provided their ration consists of a proper combination of grains and leafy foods.

One milk advertisement is rather peculiarly worded. The originator thereof believes that without vitamines we would only half exist, when, in fact, we would cease to exist.

An advertisement regarding a certain brand of margarin is not false, but is peculiar from a business viewpoint. It calls attention to the high quality of the oleo because of the high vitamine content of the milk used in its manufacture. A strict interpretation of this advertisement would be construed as advice to eat butter. Margarin has reached the point where it can stand upon its own merits, and need not depend upon its slight association with the dairy industry to make its sales effective.

There has recently been put on the market an article consisting of condensed skimmed milk emulsified with cocoanut oil. It is devoid of vitamine A, is sold for what it is, is labeled, "Do not use for infant feeding," and saves considerable skimmed milk which otherwise would go into the sewers. An attempt is being made to prevent by legislation, the interstate shipment of this article for the purpose of saving the lives of children who would be given the article for food. The proponents of this measure do not consider that a mother who would feed her child an improper diet in one respect would continue to select improper diets if one objectionable substance were removed. It would be disastrous to adults if only infant foods were permitted access to our markets.

Vitamines and the Yeast Craze

The yeast fad is peculiar. Yeast is high in vitamine B, but why eat yeast cakes when so much more palatable foods containing the same substance in abundance are readily available.

A recent yeast advertisement quotes a diet including boiled potatoes and buttered peas, claiming deficiency unless yeast is added. Unfortunately the paper carrying the advertisement is published in another state, and Massachusett laws are not applicable under such conditions. Another reads: "They pay heavily for it in later life," but it also could say: "They pay heavily for it now." And still another reads: "Add two or three cakes to your own daily diet and note the difference," which statement could readily refer to increased cost of your meals.

The statements regarding the vitamine B content of yeast are substantially correct, but the insinuations that the general public is subsisting upon a low or vitamine-free diet are incorrect.

Commercial yeast contains about 55 per cent starch and 25 per cent water and is sold at $1.43 per pound. The protein-content is about 6 per cent. If the starch is deducted at 8 cents per pound, we are paying $3.09 per pound for an article containing 13.3 per cent protein with a fuel value of 284 calories per pound, or at the rate of $12.45 per 1,000 calories. Steak cod, 16.7 per cent protein, 0.3 per cent fat, 325 calories per pound, at 15 cents per pound costs $1.96 per 1,000 calories. Turkey at 65 cents per pound, 21.1 per cent protein, 22.9 per cent fat, allowing 25 cents per pound for the fat value, will cost, fat free, 76 cents per pound for 27.4 per cent protein and 511 calories per pound, or $1.49 per 1,000 calories. Spinach, strictly a nutritional and dietary food, consumed largely for its vitamine content, at 25 cents per peck, or 8 cents per pound, will cost $2 per 1,000 calories of protein. Yeast is an expensive food.

Vitamines and Dr. Wiley

One cannot grow fat on vitamines alone, neither can one do any work on vitamines alone, but in addition one needs some fat, some carbohydrates, a variety of proteins and mineral substances. A deficiency of any of these will produce serious pathological disturbances which require the services of the skilled dietitian, who can make a proper diagnosis of the trouble, rather than those of the proprietary medicine man who does not know you or your trouble.

The popular application of our knowledge of vitamines is to eat three square meals a day and do not worry. This was well expressed by Dr. H. W. Wiley at the last meeting of the Association of Official Agricultural Chemists, as follows:

> Milk and greens have Vitamines, enough for little Sid,
> So he, at least, will need no yeast—a real self-raising kid.

Council of Associated Technical Societies of Cleveland

Impelled by the precedent of technical professional men in the Detroit territory in organizing the Associated Technical Societies of Detroit, effective Jan. 1, 1922, embracing the Detroit chemists and local sections of the American Chemical Society and American Institute of Chemical Engineers, the Cleveland Engineering Society at a special meeting, June 20, approved a plan to form an association of that society and of the local sections of the national technical societies and other scientific societies, to be known as the Council of Associated Technical Societies of Cleveland.

The object of the organization will be to coordinate the actions and further the aims of the various technical societies in Cleveland and vicinity. The proposed constitution provides for a council consisting of the president of the Cleveland Engineering Society as chairman ex-officio and the chairman of each local section of a national engineering society or other associated organization. There are fourteen local sections of national technical societies in Cleveland and it is expected that most, if not all of these, will become affiliated with the council.

Lime Specifications for Glass Manufacture

By R. R. Shively

Chemical Engineer, Monongah Glass Co.

GLASSES are fused mixtures of (1) an acid, i. e., silica, rarely boric acid, and (2) an alkali, generally soda, and (3) an alkaline earth, usually lime. The fused mixture of sand and soda is quite soluble, and we know it as water glass. The addition of lime decreases the solubility. A glass containing about 8 per cent. of lime is very insoluble.

All three forms of lime, viz., limestone, quicklime and hydrated lime, are used in glass-making; each has its supporters, who believe that good glass cannot be made from any other form of lime. Certain manufacturers will not use a lime containing 3 per cent. of magnesia, while others prefer a dolomitic lime with 35-40 per cent. magnesia. Without any intention to discuss thoroughly the various phases of the lime problem as it arises in glass manufacture, we seek here to give specifications which have proved satisfactory in many instances, and some of the reasons therefor.

Appropriately may be mentioned, by way of introduction, a few recent developments in the glass industry, which have greatly influenced progress in this art, and which have been responsible for much greater care being taken in the selection and control of quality of glass-making materials. In recent years, a great stride has been made in glass-forming machines, and these machines require glass of constant physical properties. The hand operator can make his manipulation suit the glass, but the glass must be made to suit the machines. These machines have been responsible for increased production, and materials must be selected with this point of view.

Another thing which has been responsible for more careful specifications of glass-making materials is the passing of natural gas. The producer gas is less constant in composition and there is more or less heat variation which tends to retard the plaining-off of the glass. In recent years selenium has come into general use as a decolorizing agent in certain kinds of glass. This material has supplanted manganese and nitre. Without nitre present to oxidize the organic matter in limestone an objectionable color is produced. This has caused some manufacturers to revert to quicklime.

Limestone has many advantages over other forms of lime, the most important ones are low cost, constant composition, and less objectionable properties as regards handling. The chief objection to limestone is that it requires more heat to melt a limestone batch than batches of quicklime or hydrated lime. From a thermo-chemical standpoint this is true, and practical experience has verified the thermo-chemical data.

Quicklime is preferred by many, because of its being less difficult to melt, and its practical freedom from organic matter. It is objected to because of its being unstable, unpleasant to handle and expensive.

Hydrated lime is used but little, but is recommended by some because of the benefit said to be derived from the expulsion of water in the melting process. It is unstable, expensive and harder to melt than quicklime.

In giving specifications for lime products for glass-making, first must be mentioned that there is a wide variation in the requirements of different factories. This is caused by the size of the tank furnace, and by the quality and kind of glass being made. Where window glass is made, coarse limestone usually is preferred, and the iron-content may be as high as 0.8 per cent., while with tableware a finely ground product is preferred, with not more than 0.2 per cent. of iron. Accordingly, it is the idea of the writer that each factory should find its requirements and that these should be adhered to very closely.

Lime Specifications

All requirements of the different factories could come under the following specifications:

The alkaline earth-content should be not less than 90 per cent. and should not vary more than 2 per cent. from the established specifications.

The iron-content should be as low as possible and the general range is from 0.1-0.8 per cent. This should not vary more than 0.1 per cent. in various shipments.

The alumina- and silica-content is not objectionable, but when once established the alumina should not vary more than 0.5 per cent and the silica not more than 1 per cent. from the established composition.

Sulphates are objected to by some, which objection the writer really does not feel is entirely justified; nevertheless, we have established the specifications of 1 per cent. sulphates in limestone and not more than 1 per cent. sulphur as sulphates in quicklime.

In quicklime the loss on ignition should not be over 3 per cent. as shipped.

Fineness is an important factor, which is governed entirely by the requirements of different factories. In large tanks coarse stone is better than fine stone; if the tank is being pulled up to capacity some believe that fine stone will increase the production. Unless otherwise specified, all limestone and quicklime should pass a 20-mesh sieve.

These specifications vary but little from those recently published in Bureau of Standards Bulletin No. 118. The writer feels that the adoption of these specifications will go a long way toward helping the glass manufacturer, and also will help the lime manufacturer in knowing what is expected of him.

The writer is of the opinion that 90 per cent. of the troubles in glass-making due to materials come from lime, which opinion in no wise contradicts the conviction that much of the trouble commonly attributed to the glass-making materials arise from other causes.

With the formation of the Federated American Engineering Societies, the employment service maintained by the secretaries of the societies of civil, mechanical, electrical and mining engineers for their respective organizations at 29 W. 39th street, New York, was sought to be made a national function of the federated societies. The smaller engineering societies more or less remote from New York, saw no benefit from such service under federated operation and were disinclined to support it, on the ground that such service is essentially local and personal and of benefit almost entirely to those resident in the vicinity of headquarters.. Membership census showed that about 20 per cent are so resident and that about 80 per cent of the cost is a burden on that portion of the membership which derives no benefit from it. Accordingly the federated societies have returned the control of the service to the jurisdiction of the respective societies.

---

[1] A paper presented at the [illegible] Annual Convention of the National Lime Association, Cleveland, Ohio, June 16, 1922.

Industrial Statistics and Waste Elimination

THE importance to the material welfare of the people of the organized scrutiny now being directed by public-spirited and social-serving engineers to our methods of production and distribution is not being emphasized as it should that its educative value may have fullest effect where it is needed most, i. e., with the people. So long as the people, i.e., the consumer, are satisfied to pay for waste we will have wasteful methods. The consumer can be educated to demand that waste in industry shall be eliminated only to the degree that he can realize that he will benefit measurably from the introduction of more efficient methods in the production and, chiefly, in the distribution of goods.

The significance of industrial research in waste elimination, in the first instance, must be brought home to the manufacturer, and this most effectively through the agency of the trade association. Every process in production is a compromise between an ideal condition and the local exigency, the amplitude of which extremes being determined by what the consumer can pay. What the individual manufacturer will do to eliminate waste in his production methods is determined as a rule by what his competitor is doing or by the prospect of profit as regards any given change. Individual advantage in the form of increased profits, which induces the introduction of the improved procedure, eventually, under the stress of competition is passed on to the consumer, with a residue represented in the increased profit that flows from a larger volume of output. Leaving entirely to competition the responsibility for the enforcement of more efficient methods is to neglect the potency of intelligent public opinions in demanding, on the one hand, an ever greater abundance and cheapness of goods, which is the foundation of material welfare, and on the other, that those methods shall be pursued which contribute most to this end.

That the results of the investigation of wastes in industry and of ways to eliminate them, instigated by Herbert Hoover and promoted by him in his capacity as Secretary of Commerce, are penetrating the public consciousness, is evidenced by the following statement of the American Exchange National Bank, New York City, in which is set forth the importance of quick and accurate industrial statistics to any program of waste elimination in its broader aspects.

Knowledge of Consumption Needs and Production Capacity

Unconsciously to most of us, and its significance unappreciated by 90 per cent of those who are contributing to it, the development of industrial statistics —the growth of exact knowledge concerning human needs and the capacity of productive machinery for meeting them—is slowly revolutionizing methods of production and distribution in the interest of the elimination of waste. At the same time it is providing us with the means for a confident modification of the political checks and hindrances which it was inevitable we should throw around the agencies of production as long as we were ignorant of their accomplishments and suspicious of their motives.

This latter phase of the development of industrial statistics is perhaps more immediately important than the former, for uneconomic controls and ignorant interference with industry, growing out of fears that it might attain political dominance, have the power to destroy initiative and completely wreck the industrial machine. Exact knowledge concerning plant capacities and the consumption demand for goods, published to the world, leaves no possible loophole for abuse of power by monopoly or any other agency. Such knowledge places absolutely in the power of public opinion, to say nothing of governmental authority, those who would gouge by restricting production in a time of urgent demand. Under a system which furnished the world with full and complete information concerning plant capacities, the current rate of production and the extent of the demand for goods, the mulcting of the public would be morally impossible, regardless of the degree of centralized control to which a particular industry might be subject.

Unfortunately, this state of perfection in the gathering and distribution of statistics has not been reached. Its development is in process and great progress toward that end has been made, but we are still some distance from the ideal. The progress already made is nevertheless sufficient to indicate the possibilities and to justify a reconsideration of our policies and ideas concerning the necessity of maintaining political controls over economic forces. In such a reconsideration it is possible we would discover that it was still advisable to maintain some form of political control over the agencies of these forces, but even in that case it is certain we would conclude that it was no longer necessary to exercise that control after the manner now in vogue.

The Demagogue and the Bedevilment of Business

In an atmosphere of knowledge the survival of the demagogue is an impossibility. The demagogue feeds on ignorance and breathes the air of suspicion; deprived of that atmosphere he would die like a fish out of water. As things are, the demagogue is responsible for 90 per cent. of the ignorant interference with economic development. The substitution of informed control for the control which he breeds out of ignorance and envenoms with suspicion would represent an advance even in the eyes of those who condemn artificial control of any kind.

Those who object to artificial control of the natural forces do so upon the ground that even the fullest possible knowledge of present tendencies cannot be a reliable guide to the future, for the simple reason that all the factors which are to shape the end cannot be known because they have yet to appear. But conceding the expediency of some form of control, the ideal would seem to be a form which could and would be adjusted to meet contingencies as they arose.

Exact knowledge of the character and form of industrial progress, as revealed in statistics, should give us the confidence which comes from knowing what we are doing and enable us to make adjustments in accordance with the commands of sound policy and good reason. The bearing in this connection of the number of pounds of sugar consumed per capita in this country in the course of a year, or the number of miles an automobile tire will run before it is ready for the discard, may not be immediately apparent to the politicians, but when coupled with complementary statistics showing the number of pounds of sugar produced, the number of automobiles operated and the number of potential automobile owners, this information gives the industrialist and the statesman a fairly accurate forecast of what is likely and what ought to happen in the industries concerned.

Placed beside information showing plant capacities, current rates of production and the like, the statistics operate to prevent waste, thereby conserving capital, and act as a check upon the rapacity of individuals who, in the days when producers knew very little about their own business and nothing about the business of their competitors, and the public knew less, were able to pirate at will, regardless of restrictive laws and regulations.

The Chemist and Advertised Goods

Inspection of a list of the 50 leading advertisers in 36 publications during 1921, compiled by the Curtis Publishing Co., Philadelphia, Pa., cannot fail to register the intimate indispensability of the chemist to the development and maintenance of quality of many of the products advertised. While this list is designed to show the importance of publicity in the distribution of goods and the partial investment in 1921 by the corporations mentioned in this form of service, the predominance of strictly chemical industries is notable, and in none is the work of the chemist neglected as an essential part of the success of the work of production. The progress of the chemist as a factor in American industry could have a no more striking exemplification.

Joseph Campbell Co.	$1,316,095
Victor Talking Machine Co.	1,239,693
Procter & Gamble Co.	1,198,458
The Congoleum Co.	783,431
Swift & Company	694,600
The Pepsodent Co.	680,770
California Ass'd Raisin Co.	659,635
Lever Bros. Company	646,277
The Barrett Company	612,249
Colgate & Company	596,781
Goodyear Tire & Rubber Co.	593,685
Fels & Company	583,510
The Quaker Oats Co.	553,892
Eastman Kodak Company	553,375
Cudahy Packing Co.	543,090
The Palmolive Company	524,797
Columbia Graphophone Co.	497,411
Andrew Jergens Company	484,885
Vacuum Oil Company	479,464
Postum Cereal Co., Inc.	466,312
Lehn & Fink, Inc.	448,250
The R. L. Watkins Co.	438,682
Corn Prod. Refining Co.	429,506
The Fleischmann Co.	419,872
Northwestern Yeast Co.	390,070
Famous Players-Lasky Corp.	385,250
U. S. Rubber Company	382,523
Alfred H. Smith Company	371,205
American Radiator Co.	370,801
Johns-Manville, Inc.	369,580
Dodge Brothers Co.	369,132
The Bon Ami Company	350,387
Cream of Wheat Company	348,770
Armstrong Cork Company	345,903
Southern Cotton Oil Trad. Co.	339,246
General Electric Company	333,642
Thomas A. Edison, Inc.	326,471
Pompeian Company	311,591
Union Carbide & Carbon Corp.	309,903
Brunswick-Balke-Collender Co.	302,975
International Silver Co.	302,220
Firestone Tire & Rubber Co.	302,027
United Drug Company	300,222
General Cigar Co., Inc.	286,460
Morris & Company	282,030
Hart Schaffner & Marx	279,407
LaSalle Extension University	277,942
Maxwell-Chalmers Co.	272,200
California Fruit Growers' Ex.	265,106
Hupp Motor Car Corp.	264,500

* * *

F. Goodwille, chief chemist, Detroit plant Solvay Process Co., will spend two months in European travel.

Activity in Artificial Silk Manufacture

Increase in American consumption of artificial silk, a chemical product, from 2,500,000 lbs. in 1912 to about 20 million pounds in 1921, which was about one-half of the natural silk consumption, is reflected directly in increased facilities for its production. The Viscose Co., the first successful and largest American producer, in addition to enlarging its Lewiston, Pa., plant, is expanding its Marcus Hook, Pa., plant, now employing 5,000 hands, to proportions that will make it the largest in the world. The Cellulose Silk Co., in its plant at Chester, Pa., expects to have 400 operatives at work by Sept. 1. The Du Pont Fibre Silk Co. has under construction a new $2,000,000 unit at its plant near Buffalo, N. Y.

Domestic artificial silk manufacture received a great impetus from the import restrictions due to the war which, in reducing the 1914 imports of 2¾ million pounds to about 300,000 pounds per year, increased domestic production to the degree that by the end of the war it had attained a volume of over 6 million pounds from 2½ million pounds produced in 1914. The inability of continual expansion in domestic production to overtake expansion in buying is evidenced by our post-bellum increase in imports.

Activity in the artificial silk industry in England and the Continent is noted especially in Belgium, which before the war produced one-quarter of the world's supply, where the largest of the four mills reports that present demands exceed production. In Belgium by the end of 1920 the industry had attained 70 per cent. of its pre-war status, and now looks with trepidation on further expansion because of tariff restrictions of importing countries. A Belgium producer is considering establishing a plant in Japan, where by virtue of cheap labor artificial silk can be imported and the fabric produced therefrom manufactured greatly below the production costs of other nations.

In the development of the American artificial silk industry we find the projection of the enterprise of the three nations in which the art has attained pre-eminence, viz., Courtaulds, Ltd., Coventry, England, in the Viscose Co., Marcus Hook and Lewiston, Pa., and Roanoke, Va.; Tubize Artificial Silk Co. of Belgium in the American plant at Hopewell, Va., and the corporation of the Comptois des Textiles Artificiels, Paris, France, with E. I. du Pont de Nemours & Co., in the establishment of the Du Pont Fibre Silk Co.

Improvement in processes of manufacture has increased the possibilities of the use of artificial silk to the degree as to establish the product firmly as an important branch of the silk industry. In knit goods, trimmings, hosiery, draperies, many sorts of dress goods, sometimes alone and sometimes in combination with cotton, wool or silk, the artificial product has become a textile fibre of importance.

Not only manufacturers of specialties, but those in regular silk lines have found it of value. The reasonableness and comparative stability of the prices of artificial silk yarn add to its favor in the eyes of the manufacturer. The retail trades and the public, moreover, it is claimed, have come to realize that it has a legitimate place, and that, where no misrepresentation or misbranding occurs, artificial silk goods are economical and practical for many purposes.*

---

*Artificial Silk Manufacture: Origin, Development and Present Status of the Industry of Artificial Filament Formation. By Leo Rotstein, University of New York, 1921, pp. [illegible]

Tank Cars for Transportation of Muriatic Acid

Experience of the Hooker Electrochemical Company in the Development of Acid-Proof Containers for Car-Lot Shipment of Muriatic Acid

By J. M. Rowland
Chief Engineer, Hooker Electrochemical Company

TANK cars for shipping muriatic acid have in the past been of two general types, viz., single and multiple units. The tanks have been built of wood which has been treated by impregnation or coating with acid-resisting compounds to withstand chemical attack. Experience has shown that the maintenance cost has been high. In order to develop a container that will better resist the chemical action as well as the racking strains of transportation, several different types and materials of construction are now under test. We are concerned here only with the work that has been under the writer's direction, and will endeavor to outline the reasons that led up to the present design and give the results obtained to date.*

Development of the Idea

In 1914 the Hooker Electrochemical Company manufactured its first muriatic acid which was obtained as a byproduct from the chlorination of benzol. The plant was enlarged in 1916 to a daily production of approximately 30 tons of muriatic acid. With this production the question of storage became important and wooden tanks were provided for this purpose. The tank staves were impregnated by boiling in tar before assembling, and after assembling several coatings were given. The tanks leaked badly so a number of different compounds and mastics were tried but without success. A tank would be tight for a short time and then start a small leak that would gradually increase. Without a storage, all acid produced had to be caught directly in carboys which was far from satisfactory. After spending six months and going to a material expense in an endeavor to make the wooden tanks reliable, we heard of the unvulcanized para rubber lining, and immediately installed one storage tank of 8,500 gallons capacity. This gave good service and later two more were installed.

After the Armistice monochlorbenzol production dropped very low and consequently the acid. It was then that our company started making its "Hooker White" and "Chemically Pure Hydrochloric Acid" which is made by the direct union of the two gases.[1]

The process for making muriatic acid by burning proper proportions of hydrogen and chlorine, whereby hydrochloric acid gas is formed, has been simplified and developed to such a state that it can be done successfully on a commercial basis. The hydrochloric acid gas as it comes from the burners is of very high purity, so the question of making muriatic acid of high purity resolves itself into preparing pure water for the reaction with the gas, and in using apparatus throughout of such character and quality that it will not contaminate the acid.

These factors have been satisfactorily worked out by the use of distilled water for the absorbing medium and by exereme care being taken in the selection of all materials used for construction purposes from the burners through the cooling and absorption system, and including the handling, storage, and final shipping containers.

Grades of Muriatic Acid Made

Several kinds of acid are prepared in any density up to 22° Bé. Our commercial muriatic acid is yellow in color from the dissolved iron contained in it and contains also small amounts of lime salt, but absolutely no arsenic or heavy metals. Iron runs less than .005 per cent, non-volatile .005 per cent and sulphuric acid .0014 per cent.

"Hooker White" muriatic acid is the next higher grade produced and with the exception of color, which is kept below .0001 per cent iron, is practically the same in composition as the commercial muriatic. The "White" acid fills an important need in such places as the manufacture of dyes and their intermediates, food products, etc. "Hooker C. P. Hydrochloric Acid" is the highest grade produced and runs less than .0001 per cent iron, .0001 per cent nonvolatile, and less than .0001 per cent sulphuric acid. These are the only impurities present in this grade of acid; it is used in the manufacture of especially fine products requiring materials of the highest grade.

Acid-Resistant Tank-Lining

Such purity once obtained must be maintained and it was found that the unvulcanized rubber would accomplish this as well as glass. Therefore, the rubber lined storage became more important. One of the storage tanks about two years ago, had the rubber lining of the bottom entirely destroyed by benzol. Through an accident some chlorinated benzol went over with the acid into the storage and settled to the bottom of the tank in a layer probably one or two inches deep. When this was discovered the tank was emptied and the damaged rubber removed. The lining was stripped to a level about 8 inches above the bottom. The acid soaked wood of the tank bottom was washed and neutralized and a new light wooden flooring laid on top of the old bottom wood. This was given a new rubber lining which was carried up on the tank walls and bonded with the old rubber. This repair was successful, was accomplished quickly, and the tank has been in continuous service ever since without leakage or showing signs of any weakness.

In 1919, our company was anxious to make tank car shipments, but owing to the difficulties that others were having, it did not wish to invest in any of the tank cars that existed at that time. On account of the successful and satisfactory results it had experienced with the stationary storage tanks made of wood and lined with pure unvulcanized rubber, it decided that this material was worth further study for transportation purposes, and late in the year of 1919, the author was detailed to carry through an investigation. The experience of others who had experimented with transportation tanks lined with para rubber was discouraging, as several attempts had met with failure.

Construction of the Tank Car

As far as could be learned, the experiments had been tried entirely with cylindrical tanks placed in a horizontal position, and the failure had resulted from the rubber lining loosening and dropping away from the top of the tank. This failure was attributed to two principle causes, viz., (1) the racking strains of transportation which are not met with in quiet storage. and (2) acid being spilled or overflowing the top of the tank, soaking through the wood or the joints between the staves and destroying the canvas friction which acts as a bonding medium to secure the rubber to the wood.

---

* A paper presented at the Niagara Falls meeting, American Institute of Chemical Engineers, June 19-22, 1922

[1] See CHEMICAL AGE, June, 1922; Townsend Hydrochloric Acid Process.

In view of the above difficulties an experimental tank of rectangular shape was designed in January, 1920, and, after further physical tests of the materials, was constructed and put into service in September. This tank was mounted on one end of a flat car (See Fig. 1) and, with the balance of the car loaded with carboys, made three trips from Niagara Falls to the Pittsburgh district.

In April of 1921, this tank was mounted on a permanent car together with three additional tanks of the vertical cylindrical type and has been in continuous service ever since (See Fig. 2). At the same time a second car fully equipped with vertical cylindrical tanks was built. The service of these two cars proved satisfactory and in September, 1921, the writer was instructed to build nine additional cars, eight for the service of the Hooker Electrochemical Company and one for service in Mexico.

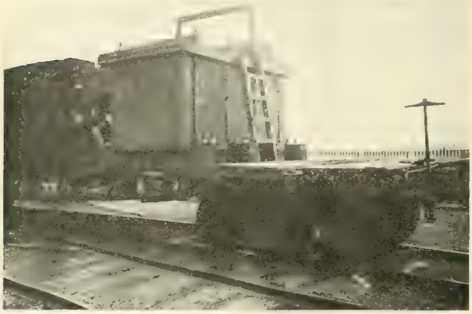


Fig. 1. Early stage of the development of the Hooker tank car for the shipment of muriatic acid.

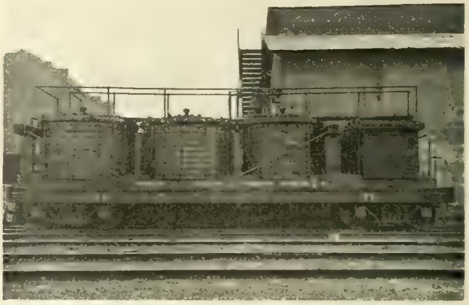


Fig. 2. Intermediate stage of the development of the Hooker tank car for the shipment of muriatic acid.

These cars were all built from the same design as illustrated by Fig. 3, each car being equipped with four vertical cylindrical cypress tanks lined with pure unvulcanized para rubber. Each car will carry approximately 35 tons of 21° Beaume hydrochloric acid.

The work was started September 7, 1921, the first car completed October 15 and the ninth November 2nd. Owing to the short time allowed, it was necessary to buy existing gondola cars, strip them, overhaul the underframes and trucks while the tank work was progressing separately. All cars have operated continuously since being put into service with no tank leakage to date. On return to the plant the tanks have been opened, washed and inspected internally on an average of every second trip. From January 1 to May 15, 1922, the fleet of ten cars has been 996 car days enroute and 354 car days at the plant, or approximately 74 per cent of the time away.

Inspection of the 40 tank linings to date shows no failure of the rubber from chemical attack or mechanical strains. Two tanks have had the rubber lining of the bottom punctured by a metal pipe which was used for unloading. These were repaired without removing the tank covers and are in service in good condition. The seven cylindrical tanks installed on the first two cars in April, 1921, showed failure of the cover lining within a few trips, and in the design of the cars built last fall, further steps were taken to guard against this weakness.

Details of Construction

After completion of the last cars the covers of the above seven tanks were removed and rebuilt in accordance with the latest design, and to date there has been no indication of any further cover failure. It is interesting to note that while these covers failed, there was no injury to the tank body. The experimental tank above mentioned which has now been in service for 20 months, was designed as an open-top tank with the cover a separate unit, so that failure of the cover would not injure the tank, and to accomplish this the rubber lining of the inside of the tank was carried over the tank edge and a few inches down the outside; this principle has been followed on all succeeding tanks. The experimental tank is rectangular in shape, being 4 feet wide by 8 feet long by 4 feet high and placed in a transverse position at the end of the car. It is of laminated construction, the sides being built of 2 x 4 cypress laid flat, spiked together, and having dowel bolts at the dovetail corners and also about 24 inches spacing between. When tanks for a full car were designed the vertical cylindrical shape was adopted for the following reasons: Economy in construction; to keep all metal on the outside of the wood; to keep the joints between staves vertical; and to secure the largest bearing area for the tank load. Experience to date has justified these features.

In constructing the last nine cars all car decking was removed and the tank dunnage carried on heavy wooden stringers that are supported by and secured directly to the steel frame of the car. This renders the steel underframe accessable for inspection, cleaning and painting, and removes the menace of an acid-soaked deck against the steel. The underframes used are of the fish-belly type. On them are mounted four longitudinal yellow pine stringers. The central stringers are bolted directly to the center sills and transmit through bearing blocks the individual bottom thrust of each tank to the center sills. The side stringers are also provided with bearing blocks. At each end of the car is a heavy wooden bolster beam near the top of the tank, and by means of struts in the tanks and blocking between the tanks the upper strains are transmitted to the bolsters, and in turn to the side sills near the center of the car through the diagonal tie rods. In addition to the above and to assist against the overturning moment, the covers are provided with holding down bolts that extend down through the main stringers. The most severe test to date of this anchorage was car HECX 205, which was in collision of suf ficient force to break the draft gear and the 12x14 yellow pine bolster; a careful examination of the tanks, however, failed to show any injury to the lining or balance of the anchorage.

Each tank cover is equipped with a permanent built-in siphon extending into a well in the bottom of the tank, also a vent, measuring well, and manhole. Each car is equipped with a permanent siphon priming apparatus consisting of a water jet vacuum pump, sight bottle, and rubber tubing to reach the furthest siphon. With this device by connecting a ¾" water hose to the vacuum pump the siphons may be primed and all four tanks unloaded at the same time without the necessity of opening any tank, without fume, and without introducing water or priming liquid into the acid of the tank, this last being important where acid of high purity is desired. When the car is standing on a level track the tanks can be emptied entirely except for such acid as runs back the 1½" hose when the siphon breaks from air entering its suction. At the plant these siphons with their priming device are in daily use with good success.

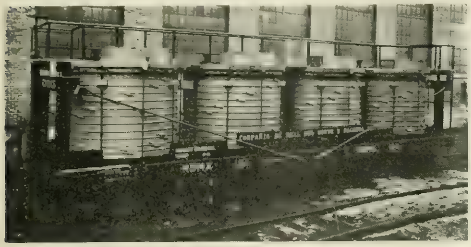


Fig 3. Present stage of development of the Hooker tank car for the shipment of muriatic acid.

In a recent test a siphon was broken and reprimed 26 times in emptying a tank to determine the time consumed and particularly the difficulties in priming at lower levels. The primes varied from a full tank to ½" depth in the tank and at no time did it require more than one minute to make the prime.

Acid-Resistance of Unvulcanized Rubber

The writer has received the suggestion from one of the rubber manufacturers that possibly HCl in its gaseous state might penetrate the para rubber sufficiently to destroy the friction fabric which is used as a bonding medium between the rubber and the wood. This is of particular interest and it has been observed that the friction fabric when exposed to HCl fume alone will be destroyed; but whether or not this fume can penetrate the unvulcanized para rubber and how long it would take, is a question to be determined. At the present time physical tests are being conducted which it is hoped will throw some light on this question, and also further tests are under way to determine with what success the para rubber may be cemented directly to the wood without the use of friction fabric. The writer does not anticipate failure of the rubber lining in the tank cars above described due to fume penetration of the rubber because the quiet storage tanks have shown no evidence of this after many years service, and to date the rubber lining of the transportation tanks shows no sign of racking strains, or evidence that its condition is different from the quiet storage.

Summary

To summarize our Company's experience with unvulcanized para rubber lining, we have the following facts: We have had in service of quiet storage, one tank five years, one tank four years, one tank three years, and have had no trouble whatever with leakage and have made one major repair with ease and success whom the rubber was ruined by a foreign substance. In the transportation service we have had one tank in continuous operation for 20 months without leakage, and have, at different times of inspection, cut away samples for examination and patched the spots so cut. We have had two cars or seven additional tanks in continuous service for more than one year with no tank leakage. The covers of these seven tanks, however, were renewed. We have had for seven months, eight cars or thirty-two tanks in continuous service without leakage or repair of any character except two tanks which were punctured by an iron pipe. We have received favorable reports from one car containing four tanks that went to Mexico, and are advised that it has made five trips to date and has shown no leakage.

In conclusion the writer believes that muriatic acid tank cars with the unvulcanized para rubber lining are a success from the viewpoint of design, cost of operation, and initial cost. Their reliability is a marked advantage. When a car returns it is a help to be able to reload and ship it out immediately and not be obliged to delay several days for repairs. The unvulcanized para rubber is a delicate material and when handled properly will give the desired results. Its success is dependent upon extreme care in design and construction.

Brick from Blast Furnace Slag

E. P. Gangewere, Lehigh University, South Bethlehem, Pa., has devised a plan for the utilization of blast furnace slag for brick manufacture which embraces the following steps:

1. Discharge slag directly from furnace into cars filled to depth of several feet with water.
2. Place disintegrated slag into centrifugal drier.
3. Run product through pulverizer, crushing slag to such degree that 75 per cent will pass through a 100-mesh sieve.
4. Mix one part of cement to twelve parts of powdered slag, adding small amount of water.
5. Mold the resulting mixture in presses to bricks of standard size.

Bricks thus produced from slag of the Bethlehem Steel Co. furnaces at Bethlehem, Pa., have been tested at the Fritz Engineering Laboratory at Lehigh University by Mr. Gangewere, who reports results that show that bricks produced from blast furnace slag have a strength far above the average produced from shale or clay. The texture of the bricks is uniform, and an even, smooth surface results from this method of manufacture.

Cost of production is claimed to be far less than that involved in making bricks from clay or shale, and the whole process can be operated in conjunction with blast furnaces.

As a result of laboratory tests made at the College of Industries of Carnegie Institute of Technology, Pittsburgh, the claim is made by the Institute that it finally has been established that bituminous clay pipe for drainage and sewerage use is in every way the equal of the more expensive cast iron pipe which has been employed heretofore. Details can be obtained by addressing R. S. Clark, office of the secretary, Carnegie Institute of Technology, Pittsburgh.

Progress in Phosphoric Acid Production for Fertilizer and Food Purposes

By William H. Waggaman
Scientist in Fertilizer Investigations, Bureau of Soils, U. S. Department of Agriculture.

THE most extensively used chemical reagent is sulphuric acid, aptly termed the "King of Chemicals," for so few are the industries in which this acid is not used, directly or indirectly, that its loss would involve the paralysis of industry. The manufacture of other mineral acids, as nitric, hydrochloric and phosphoric, is dependent largely upon sulphuric acid[1].

It is obvious that it would be poor economic practise to employ these other mineral acids merely as reagents when their manufacture depends upon sulphuric acid which is usually more effective, cheaper and more readily handled and shipped. On the other hand, the chief function of sulphuric acid is that of a reagent, since it usually adds nothing of value to the material which it treats, while both nitric acid and phosphoric acid, besides having the power to effect certain chemical changes, carry in themselves marketable ingredients which add to the commercial value of the final product.

There is every indication, however, that in the future phosphoric acid is going to play a more important part in manufacturing processes than it has in the past, for the pyrolitic or furnace process of producing this acid has progressed to the point where industry has taken it up and the numerous chemical and mechanical difficulties involved are being gradually worked out. This method obviates the necessity of using sulphuric acid in the production of phosphoric acid direct from its compounds and has certain other attractive features which point to its wide adoption.

Advantages of Phosphoric Acid as a Reagent

There are a number of advantages in the use of phosphoric acid rather than sulphuric and a number of conditions under which it may be more economically employed than the latter, provided, of course, that the cost of production is not too high. First, a number of elaborate and costly steps and factory manipulations, such as washing, screening, filtration, and evaporation, now necessary in the production of phosphates by the sulphuric acid method, would be materially reduced. Second, where sulphuric acid yields relatively valueless byproducts, phosphoric acid produces only salable material, and hence the separation or handling and transportation of worthless filler or gangue would be largely eliminated.

Ammonia for fertilizer and other purposes just as well can be fixed as ammonium phosphate as in the form of ammonium sulphate. Potassium chloride could be treated with phosphoric acid to produce potassium phosphate and hydrochloric acid as a by-product. By the action of phosphoric acid upon Chile saltpeter or sodium nitrate, we obtain nitric acid and sodium phosphate, both of which are marketable products. Third, we have in this country unlimited sources of raw materials necessary for the production of phosphoric acid by the furnace method, whereas we are importing large tonnages of pyrites from foreign sources for use in the manufacture of sulphuric acid.

Phosphoric Acid for Food and Chemical Purposes

While our main demand for phosphates in this country is for use in fertilizers, there is a large consumption of phosphoric acid in the manufacture of materials used directly or indirectly in food products, as in baking powder, self-rising flours, in the manufacture of jellies, preserves, and of soft drinks, and for medicinal purposes. The greatest consumption of phosphoric acid as such, however, is in the clarification of sugar solutions and large quantities are annually used in the refineries of Cuba, South America and this country.[1] It is also employed in rust-proofing paint, in the manufacture of salts of phosphoric acid for water-softening and boiler-scale compounds, and in a number of dental preparations. For most of these purposes a rather pure phosphoric acid is required; thus when acid is produced by the old standard method of treating phosphates with sulphuric acid very high-grade phosphate rock or bones must be employed. Acid of this character, of course, commands a premium over the less pure product employed in the manufacture of fertilizers.

Phosphoric Acid for Fertilizer Purposes

Phosphate rock for fertilizer purposes does not have to be of the highest grade, but in manufacturing acid phosphate by the sulphuric acid process it is necessary to limit the amount of such impurities as iron and alumina, in order to obtain a product which will answer the availability tests set by the state fertilizer laws and at the same time be in a mechanical condition which will admit of its ready application to the soil. Therefore, even in the manufacture of acid phosphate many grades of phosphate rock are barred, either because of their low phosphoric acid-content or the presence of abnormal quantities of aluminum and iron oxides which render them unfit for sulphuric acid treatment. In spite of these requirements, however, the phosphoric acid in fertilizers must be cheap in order to insure their wide application and enable the farmer to obtain increased yields at a price warranting their use.

Sulphuric Acid Method of Producing Phosphates and Phosphoric Acid

The familiar process of manufacturing soluble phosphoric acid by means of sulphuric acid consists of treating phosphate rock with an equal quantity of sulphuric acid and allowing this mixture to stand until the reaction is practically complete and the tricalcium phosphate is converted into mono-calcium form. The average grade of phosphate rock used for manufacturing acid phosphate contains 32 per cent of phosphoric acid and the product obtained by sulphuric acid treatment contains 16 per cent of soluble phosphoric acid. If sufficient sulphuric acid is added we obtain phosphoric acid which may be filtered, concentrated and then used to treat phosphate rock in the production of double acid phosphate, containing 40-50 per cent of soluble P_2O_5.

---

[1] [illegible]

[1] [illegible]

This product is made in Europe and to a certain extent in this country in order to utilize relatively low-grade phosphate deposits which would give a dilute product if manufactured into acid phosphate direct. Whether ordinary acid phosphate is produced by direct treatment of sulphuric acid, or double acid phosphate is the product indirectly obtained, there are certain objections to manufacturing soluble phosphate by means of sulphuric acid. Ordinary acid phosphate is at its best a relatively low-grade product; the highest on the market seldom containing over 18-20 per cent P_2O_5. Double acid phosphate produced by the sulphuric acid process involves filtration and evaporation which largely offset the advantages gained in obtaining a concentrated product. In either case a reagent is employed which adds no fertilizer value to the final product and must be manufactured at or hauled to the fertilizer plant and hauled away again either within the fertilizer itself, or disposed of as gypsum, which has little or no market value.

Advantages of Furnace Method

The direct production of phosphoric acid by a furnace method wherein silica is employed in lieu of sulphuric acid offers many advantages, provided, of course, that the cost of the fuel or energy required to produce the unit of phosphoric acid is no greater than the cost of the sulphuric acid necessary to effect the same results. In fact, the pyrolytic process may still be more economical than the sulphuric acid method should the fuel or power costs be appreciably higher, since the raw materials used in certain respects can be much lower in grade and consequently cheaper; moreover the product obtained is so concentrated that transportation and handling charges per unit of phosphoric acid are reduced materially.

Furnace Method of Producing Phosphoric Acid

Although the furnace method of producing phosphoric acid has assumed prominence only within recent years, it is by no means a new process. Apparently the substitution of silica for sulphuric acid so that phosphorus could be produced directly from phosphates of lime was first proposed by two Frenchmen, Auberton and Boblique,[1] in 1867, when these inventors took out a patent for volatilizing and collecting elementary phosphorus from mixtures of phosphate rock, sand and coke heated to a high temperature in closed containers. Ruymbeke[2] appears to have been the first in this country to patent the furnace process for the recovery of phosphoric acid rather than phosphorus. This patent was taken out in 1895 and the inventor advocated the use of a blast furnace for this purpose. Although the manufacture of phosphorus in the electric furnace was generally adopted both in this country and abroad, the manufacture of phosphoric acid in this way received comparatively little consideration and it was not until a plant of semi-commercial size was put into operation at Mt. Holly, N. C., operating under the Hechenbleikner patents, that commercial concerns began to evince an interest in this method.

The Bureau of Soils undertook investigations along these lines in 1916 and installed a simple electric furnace of semi-commercial size at Arlington Farm, Virginia. After considerable preliminary work it was found that while complete elimination of phosphoric acid could readily be brought about in this way, the complete collection of the volatilized acid required such elaborate absorption systems that it was desirable to employ a simpler method of recovering the product. Accordingly, Dr. W. H. Ross[1] of the Bureau of Soils decided to try out the Cottrell method of precipitation for collecting the volatilized acid, which worked so admirably and had such distinct advantages over the water-absorption system that it was later adopted by the first large commercial plant producing phosphoric acid by the furnace process, namely, that of the Federal Phosphorus Company, Birmingham, Ala. The preliminary work at Arlington Farm, Virginia, made it seem desirable to carry this work further so a cooperative arrangement was entered into with several outside concerns and a larger and better equipped plant was erected near the factory of B. B. Davis Baking Powder Company, at Hoboken, New Jersey. This experimental plant was in direct charge of J. N. Carothers, who, after the work was completed, resigned from the Bureau of Soils to go with the Federal Phosphorus Company.

Mr. Carothers' figures,[2] obtained after several months, showed that P_2O_5 could be produced at a cost of 3.39 cents per lb. exclusive of interest on investment, taxes and depreciation charges. This figure, I believe, has since been reduced in actual commercial operation. As pointed out by this investigator, the furnace was of very simple design and had no regenerative features or means for utilizing the heat of the effluent gases which should decrease appreciably the cost of production. By using, however, the concentrated acid collected by the Cottrell precipitator to treat another batch of phosphate rock, thus producing double acid phosphate, the final cost of the unit of soluble P_2O_5 would be reduced materially from that given above.

Use of Mine-Run Phosphates

Another very important factor, in the economic production of phosphoric acid by the furnace method which was not given much consideration in the earlier investigations is that of using lower grades and run-of-mine phosphates which are inherently unfit for the manufacture of acid phosphate or must be separated from their impurities by an elaborate screening process which adds materially to their cost. With this in mind the writer undertook a number of experiments wherein run-of-mine phosphates from Florida and Tennessee were smelted in the electric furnace, sufficient sand being added to give the proper silica-lime ratio best adapted for the elimination of the phosphoric acid and the production of molten slag.

It was found that such phosphates could be employed advantageously, provided of course, they did not have to be hauled such long distances that the freight upon the silica and other impurities present would offset the advantages gained in the utilization of these lower grade materials. These investigations brought up another point which led to the work now being conducted by the Bureau, viz., whether fuel such as oil, coal, or coke could be employed in lieu of the electric arc for obtaining the necessary temperatures and evolution of phosphoric acid, for the phosphate deposits of Florida as well as a number of those in Tennessee are rather remote from sources of cheap hydro-electric power which would make it possible to utilize the electric furnace for the production of fertilizers. Accordingly, experiments were undertaken to see if the complete volatilization of phosphoric acid could not be brought about at the temperatures and under the conditions attained in a fuel-fired furnace. Much of this work has been published, but a short review here will probably be helpful to those interested in the subject.

---

[1] Readman, J. B. J. Soc. Chem. Ind. 9, p. 473 (1890).
[2] U. S. Patent No. 540,124 (1895).

[1] Jour. Ind. & Eng. Chem., Vol. 9, No. 1, p. 26, January (1917).
[2] Jour. Ind. & Eng. Chem., Vol. 10 (1918).

Use of the Fuel Furnace

The first work was conducted with relatively pure samples of tricalcium phosphates, quartz flour, and carbon in open and closed graphite crucibles. Various proportions of these ingredients were heated in a small dental furnace employing city gas and an air blast which enabled us to obtain temperatures up to 1,600° C. The results showed conclusively that complete elimination of phosphoric acid could be obtained provided reducing conditions were maintained and sufficient silica were added to produce a molten slag. Higher proportions of silica gave a more ready evolution of phosphoric acid. The proportions used as a result of this preliminary work were silica 39 per cent and lime 61 per cent.

The work was then conducted on a larger scale and after several small furnaces were built and indirect heating employed, it was decided to use fuel oil as a heating source and have the burning fuel in direct contact with the phosphate charge. The complete utilization of the fuel and the maintenance of reducing conditions, however, are rendered difficult where oxidation is depended upon to furnish the necessary heat units. This, coupled with the fact that the run-of-mine phosphates of Florida are largely in small nodules mixed with finely divided phosphate, clay and silica, made it necessary to adopt some means whereby the carbon or coke present would not be oxidized while the phosphate mixture was being brought to the high temperature required. The plan finally adopted was to briquette the mixture and after a good deal of preliminary investigation wherein various binders were employed it was found that the finely divided phosphate and clay present in many of the deposits of Florida and Tennessee were ample to bind the mixture into briquettes which stood up excellently on furnace treatment.

The form of furnace which was used in these semi-commercial tests and the modified furnace which is now being employed is a combined blast and open hearth type wherein the briquetted charge is fed down through a central shaft into an elongated crucible. Two oil burners, one at either end of this crucible, play their flames over the molten slag and up through the shaft, preheating the charge as it melts and runs down upon the hearth. Near the top of the furnace shaft a brick-lined flue leads into a dust catcher and from the dust catcher the phosphoric acid and other gases are lead into stoves similar to those used in ordinary blast furnace practice, where the combustible gases, consisting chiefly of CO, are burned, so that nothing but oxidized products are transmitted to the precipitator.

An exhaust fan draws the gases from the stoves into the precipitator. The electrical treater consists of 9 six-inch terra-cotta pipes of seven lengths each, giving a total length of effective precipitating surface of 14 feet. This precipitator, although simple in design, has proved quite effective in collecting the acid even though the velocity of the gases is somewhat greater than that ordinarily advised. Owing to insufficient funds and our limited personnel, we have experienced a great many mechanical difficulties in running this furnace, but these gradually are being ironed out and it is hoped that before the summer is over we will have sufficient data to warrant a better and larger installation.

The longest run which we have made in this particular type of furnace is 20 hours, and during this time the furnace was operating efficiently only towards the last of the test. It is difficult to draw conclusions as to the cost of operation in a test of such short duration, but an approximation has been made, based on the last few hours of the run, which indicates that phosphoric acid (P_2O_5) can be produced by the fuel furnace process at 2½ cents per pound, including interest, taxes, overhead and depreciation charges. As pointed out before, the use of this acid for treating further batches of phosphate rock in the manufacture of double acid phosphate would materially reduce the cost of soluble P_2O_5.

Electric Versus Fuel Smelting

The limited data so far obtained is insufficient to permit of a strict comparison between electric and fuel smelting of phosphate rock, but since the function of the electric furnace is merely that of supplying the requisite heat energy it would seem that if the necessary temperatures can be attained by means of fuel (which our investigations have proven is perfectly feasible) the cost of a unit of P_2O_5 made by the fuel-fed furnace process should be materially lower than that obtained by the electric furnace method, unless electric energy is available at a price much lower than that prevailing at the present.

In the following table there is shown the equivalent cost of the heat unit obtained by fuel as compared with that furnished by electric energy, at various prices per h.p. year:

Prices Assumed for Electric Power and Corresponding Costs of Standard Fuels as Sources of Equivalent Quantities of Heat.

	Corresponding Cost of Standard Fuels Delivering Equivalent Amount of Heat.			
Electric Power Cost per K.W. Yr. Dollars	Coal per ton Dollars	Fuel Oil per gal. Cents	Coke per ton Dollars	Natural gas per M cu. ft. Dollars
5.00	4.60	2.4	4.60	20.00
10.00	9.20	4.8	9.20	40.00
15.00	13.80	7.2	13.80	60.00
20.00	18.40	9.6	18.40	80.00
25.00	23.00	12.0	23.00	100.00
30.00	27.60	14.4	27.60	120.00
35.00	32.20	16.8	32.20	140.00
40.00	36.80	19.2	36.80	160.00

This table shows very conclusively that the actual cost of the heat unit produced by various fuels is far below that at which it may be furnished by electric power unless a project, such as that at Muscle Shoals, is developed. It is not altogether fair, however, to compare the efficiency of the two methods on the basis of the cost of the heat unit furnished by each. In the electric furnace the heat is very much localized and there is much loss through radiation and in the effluent gases than in a furnace process where excess air must be introduced for the combustion of the fuel. By proper regenerative apparatus and means of utilizing the sensible heat in the effluent gases, however, this loss of valuable heat units may be materially reduced. The shaft type of furnace, therefore, whether used in connection with electric smelting or fuel smelting, appears, if properly designed, to be the logical apparatus to employ in the production of phoshoric acid by the pyrolytic process. Mr. George T. Southgate, formerly with the American Cyanamid Company, is now temporarily employed by the Bureau of Soils designing a shaft furnace of semi-commercial size which may be adapted to burning either coal, coke or fuel oil.

To offset the greater efficiency of the electric furnace in utilizing heat energy, it may be said that at present the productive phosphate fields are hardly sufficiently close to electric power sites to allow the use of run-of-mine phosphates because of the freight charges on a large amount of relatively valueless material, which though necessary to bring about the furnace reactions, does not add to the value of the product. Fuel oil in Florida, on the other hand, and coal and coke in Tennessee are relatively cheap and therefore a furnace plant might well be erected at the phosphate mines where there are unlimited phosphate resources and concentrated products could be shipped direct from the source of the raw material. With the development of Muscle Shoals, however, power could be transmitted to certain of the phosphate fields of Tennessee at a relatively low cost since some of these deposits are within 50 to 60 miles of Florence and Sheffield, Alabama. It is quite possible that a combination of the fuel and electric furnace may eventually be employed.

It has been stated earlier in this paper that it might well be possible to have the cost of fuel or electric power necessary to produce a unit of phosphoric acid greater than the cost of the sulphuric acid necessary to effect the same result. This is particularly true as regards fertilizer because of the enormous saving which would be effected in shipping the phosphate product. Under normal conditions our annual production of acid phosphate is approximately 4,000,000 tons. Of this amount, only 16 per cent, or 640,000 tons is phosphoric acid (P_2O_5). The average freight on acid phosphate is $3 a ton, so we are paying $12,000,000 a year for shipping phosphate material 84 per cent of which is relatively valueless.

Assuming now that we produce double acid phosphate containing 48 per cent of P_2O_5 instead of ordinary 16 per cent acid phosphate, we would have the same quantity of marketable ingredient in 1,280,000 tons instead of 4,000,000 tons of product. This difference of 2,720,000 tons, at an average price of $3 per ton for freight, would mean a saving of $8,160,000 annually. Fertilizer companies which purchase their acid from outside sources have to pay the freight on sulphuric acid both to and from the factory and this double charge would be eliminated where the furnace process was employed.

Conclusion

As far as the production of very pure phosphoric acid for food and chemical purposes is concerned there is little question that the furnace process is superior to the sulphuric acid method. In the manufacture of phosphates for agricultural purposes, however, the furnace process is not sufficiently far advanced to be a factor, but the time is not far distant when it will at least prove a valuable adjunct to the older and more generally employed method.

Even under the most favorable conditions, however, the use of concentrated phosphates for fertilizer purposes and the replacement of acid chambers by phosphate furnaces will come about very gradually for the American farmer has grown accustomed to relatively low grade materials and acid phosphate has up to the present satisfied his requirements. Moreover, in many manufacturing processes where a cheap reagent is required only for its acid or dehydrating properties it would be poor economic practise to use phosphoric instead of sulphuric acid. The demands of these industries are such that we must always produce large tonnages of the latter acid.

But where the use of phosphoric acid actually adds market value to the product, as it does in the case of fertilizer, it is logical to employ it and also highly desirable to produce it from its compounds by a more direct method than by the sulphuric acid process. Cheaper production and more efficient and economic distribution are equally important to the mine owner, the manufacturer and the agriculturist. The opportunity of prolonging the life of his phosphate deposits by utilizing them more fully than heretofore will appeal to the business sense of the average owner of phosphate property and the great saving in freight charges will prove attract to the fertilizer manufacturer. The pyrolytic process we believe will eventually enable the latter to produce fertilizers more economically and to offer his product to the farmer at a lower price.

Agricultural and Mechanical College of Texas

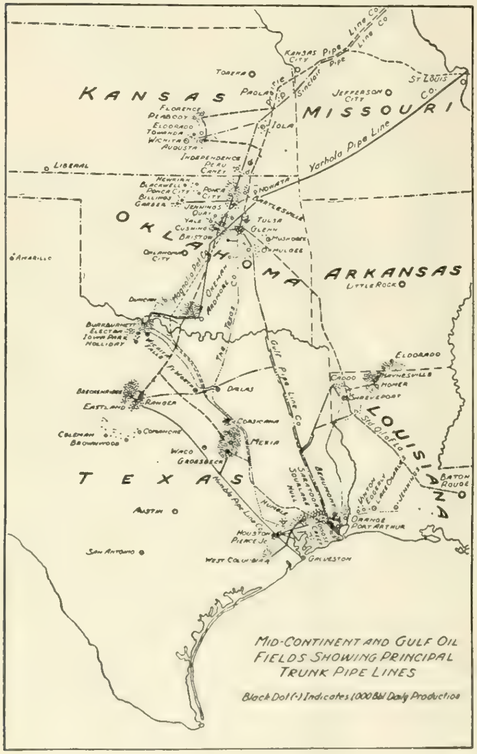
The Growth and Products of a Technical Servant of the Great Southwest

THE accompanying photograph of the 1922 class of chemical engineering graduates of the Agricultural and Mechanical College of Texas, College Station, Texas, is illustrative of the development of chemical engineering education in the Southwest and of the industrial development of this region in the production of chemical raw materials and chemical products. The latter development has its direct reflection in the success which has attended the efforts of the teaching chemists of this institution.

The department of chemistry and chemical engineering was established in 1908 by Dr. J. C. Blake, who was then professor of chemistry and to whose foresight and untiring effort are largely due the broad lines of the department's instruction and its growth to a comparable basis with that provided in chemical engineering by the older institutions of technical education. Dr. Blake resigned in 1913 to go to the Hahneman Medical College of Chicago where he is now professor of chemistry and dean of the faculty. Since Dr. Blake's resignation the work in chemistry and chemical engineering has been ably directed and developed by Dr. C. C. Hedges, who, as professor of chemistry and chemical engineering, is the head of the department.

Two men constituted the first graduating class in 1911 when W. T. Bryant and L. H. Terry received the degree of Bachelor of Science in Chemical Engineering; likewise in 1912 when M. C. Giesecke and J. W. Newton similarly qualified. The 1913 class comprised three men, viz., J. R. Christian, C. J. Holland and L. A. Hudgins; also in that year F. J. Bechert and L. B. McMillan supplemented previously attained degrees in mechanical engineering with that of Chemical Engineer, and W. T. Bryant completed his post-graduate work.

Curiosity attaches to the history of the men who were the first products of the department that in 11 years increased its graduates from two to 38 and became in the interim a recognized center of chemical engineering progress in a great region. Dr. W. T. Bryant after serving as a chemist in the control work of cotton seed oil mills and refineries and devoting study to the perfection of processes in petroleum refining, returned to the College where as associate professor in chemistry he is giving to the youth of a later day the benefit of his own technical education and his broad experience in the industries of the territory served by the school. F. J. Bechert remained two years as instructor after which he spent four years as assistant examiner in the U. S. Patent Office, during which time as a student of law he qualified for admission to the Bar and is now located at 350 Madison Ave., New York, as a patent attorney.



MID-CONTINENT AND GULF OIL FIELDS SHOWING PRINCIPAL TRUNK PIPE LINES

Black Dot (·) Indicates 1000 Bbl Daily Production

L. B. McMillan, on graduation accepted a fellowship in the Engineering College of the University of Wisconsin, where he received the Master's degree. His work in "The Heat Insulating Properties of Commercial Steam Pipe Coverings" was published in the Transactions A. S. M. E. in 1915 and the data and formulae developed by him are accepted as standards in their field. For five years Mr. McMillan taught engineering subjects at his Alma Mater and at the University of Wisconsin, he is now consulting engineer, Johns Manville Inc., New York City.

Space prevents further biographical elaboration; suffice it to say that since 1911 the department has sent out 71 young chemical engineers who are holding today responsible positions in chemical enterprises in all parts of the country. With a present staff of 15 teachers, instruction in chemistry is given to over 1,000 students, 125 of whom are specializing in chemical engineering. Inasmuch as the growth of an institution of professional chemical education of the type briefly described reflects the growth of the region served, we naturally find the greater number of its men absorbed by the industries characteristic of the region, viz., petroleum and cotton seed oil production and refining.

This year the College had the benefit of an annuity amounting to $1,250 from the Mid-Continent Oil & Gas Association, to be used in producing a lectureship on the oil industry. This lectureship has proved very successful and a great deal of interest has been shown by the students and the different oil industries. J. W. Newton, a 1912 man, is assistant superintendent of the Magnolia Petroleum Co.'s refineries at Beaumont, Texas; a 1913 man, C. J. Holland, is superintendent of control of the refineries of the Pierce Oil Corp., Tulsa, Okla.

Dr. C. C. Hedges, the head of the department whose portrait appears in the midst of his 1922 men, who constitute the largest engineering class in the history of the College, can review with much satisfaction the results of his work since 1913. Our comment of it arises from the conviction that institutions of technical education will become, with increasing industrial development, more and more community institutions for the training of its industrial leaders and for the solution of the problems of industry in the region served. The teacher of chemistry from this viewpoint becomes more than a pedagogue and will fill out to the proportions of a leader pointing the way to others in accordance with his ability to recognize and enforce the mutual obligations of Industry and the University.

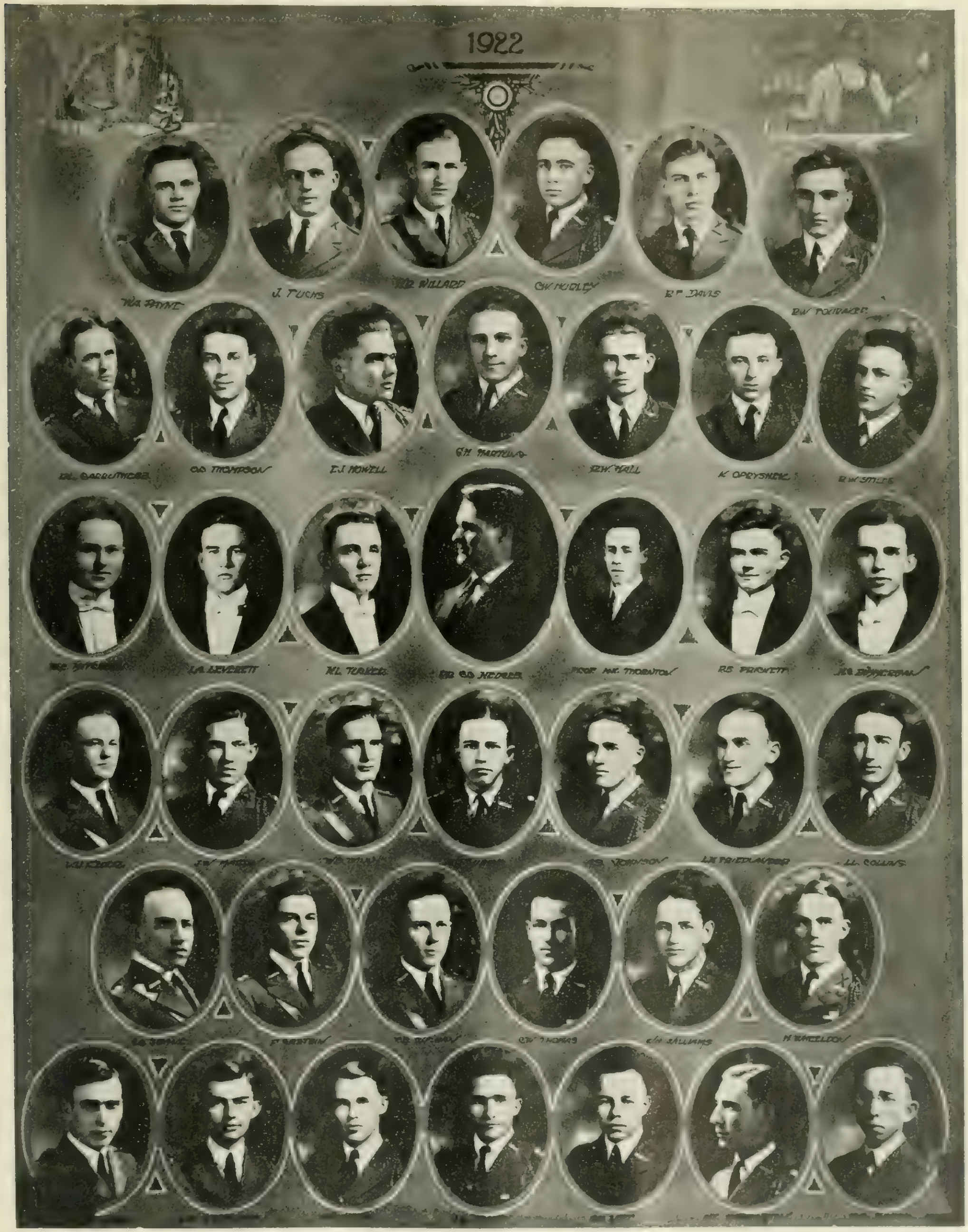
W. J. Webster, president Atlas Powder Co., Wilmington, N. J., in commenting on improvement in business conditions as reflected by the activities of his company, says that while in 1921 the first deficit in 10 years was shown, earnings for the first half of 1922 meet all fixed charges and a margin over requirements for common stock dividends which are at the rate of 12 per cent.

"Improvement in results applies to all divisions of the company's activities, and is of no little public significance, since it reflects general business betterment. Explosives are used in most of the fundamental industries; in gold and silver mining, in the iron ore districts, in zinc and copper mining, highway and railroad construction, and building undertakings generally. Sale of explosives in the coal mining districts has been somewhat curtailed, but this, of course, is a temporary condition.

"Prosperity among automobile companies has brought the company a large volume of business in its leather cloth division. This also is showing a healthy volume of sales in lacquers, which are being used increasingly in many industries, notably furniture manufacturing. From our standpoint, American business appears again to be getting into its natural stride, with every indication of healthy activity for a long time to come."

* * *

Alfred G. Kahn, Harvard '07, secretary treasurer, Rose City Cotton Oil Mill, Little Rock, Ark., has been elected president, Interstate Cottonseed Crushers Assn.



Graduates in Chemical Engineering Class of 1922

Agricultural and Mechanical College of Texas

Dr. C. C. Hedges, Head of Department

Soy Bean Industry in Illinois

A. E. STALEY MFG. CO., Decatur, Ill., will establish a plant for the extraction of oil from soy beans in conjunction with its starch and glucose plant. Storage capacity for 150,000 bushels has been provided; the first unit will have a daily capacity of 500 bushels and will be ready for handling the 1922 crop. The soy bean was first cultivated in the United States in 1804 but was never considered of much economic importance and it is only within recent years that it has been grown to any extent. Imported Manchurian beans were first crushed for oil and meal in 1910 by an oil mill on the Pacific Coast; American-grown beans were first crushed in 1915 and 1916 by a few cottonseed oil mills in North Carolina

Soy Bean Culture in Illinois

The Staley Journal says that the soy bean is a crop which can be grown to advantage on every farm in Illinois. On some of the lighter types of soil it will do proportionately better than corn, provided inoculation is present. It will grow on acid soils better than most clovers, but is helped by applications of limestone. It is a good seed producer, yielding from 10 to 35 bushels per acre, depending upon the soil, variety and climatic conditions.

The quality of the beans grown is better than the Manchurian article, due perhaps to better seed selection and more advanced agricultural practice. About 1,000 varieties have been introduced into the United States in the past ten years, but by the process of selection and elimination the list has narrowed down to a few standard varieties.

Future of Soy Bean Industry

It would seem as if the time were ripe for a steady growth and development of the soy bean industry in the United States. Although Europe is a large consumer of the soy bean and its products, it never will be much of a producer, as all the available land must be used for growing more essential foodstuffs. Manchuria and China have practically reached their limit, and by far the greater bulk of the beans must go to feed their ever-increasing populace. Besides, there is now an import tax of twenty cents a gallon on soy bean oil into the United States, which makes the importation of this article into this country almost prohibitive.

Inasmuch as soy bean oil is capable of substitution into products using linseed and cottonseed oils, let us analyze the situation from this viewpoint. The new land available for flax seed production in this country has reached its limit, and as flax is a hard crop on soils, the older land devoted to this crop cannot be expected to maintain high yields. In the South the depredations of the boll-weevil have resulted in a reduction of the production of cottonseed.

That there is a demand for soy bean oil in this country is indicated by the reports of the U. S. Department of Commerce, which show that the importation of the oil grew from 41,105,920 pounds in 1911, to 343,358,948 pounds in 1918. A large part of this increase was due to war conditions. Nevertheless, there has been a very decided development in the use of soy bean oil as a substitute for linseed oil and cottonseed oil.

Substitution of Soy Bean Oil

Statistics covering the years 1912 to 1918 inclusive, show that the use of cottonseed oil, as a lard substitute decreased from 92 per cent to 83 per cent. At the same time the use of soy bean oil as a lard substitute increased from 0 per cent to 4.7 per cent. Cottonseed oil decreased in the butterine industry from 27 per cent to 12.8 per cent. The increase in soy bean oil for the same purpose was from 1 per cent to 2.1 per cent. Cottonseed oil in the soap industry decreased from 17 per cent to 9.4 per cent, while soy bean oil, for the same purpose, increased from 0.1 to 9.3 per cent.

Thus it is evident that the principal users in both the linseed and the cotton-seed industries will be active buyers of soy bean oil. Some idea of the extent of this possible demand in the United States is had when we consider that the annual cottonseed crop averages about 12 billion pounds. The average annual cottonseed oil production is about 1,300 million lbs.

The average annual production of flax seed is about 700,000,000 pounds. To this may be added an average importation of at least as much. Thus it becomes evident that there is waiting in the United States alone, an enormous possible consumption of soy bean oil.

The total annual exportation from China, Manchuria and Japan of soy beans and soy bean products, in terms of soy beans, amounts to about 65,000,000 bushels. When we compare this with the exportation of corn from the United States, we get a more accurate idea of what this volume of business means. Since 1907, in only one year, namely 1921, has the exportation of corn from the United States been equal to the average annual exportation of soy beans. This is mentioned particularly for the purpose of removing any possible suspicion that the present activity in the production of soy beans in this country may have a glutting effect on the markets of the soy bean and its products. The fact that the annual world surplusage of soy beans is equivalent to, or more than, the total annual surplusage of corn in the United States should dissipate any possible doubt on that score.

On account of the high quality of the oil, with its many uses, and the high nutritive food values of soy bean products, there can be no doubt but that there will be a big demand for all the soy beans that can be grown in this country. This should give the industry a high potential importance, and assure its rapid development in the United States.

Eighth National Exposition of Chemical Industries

The increase in the number of exhibitors at the National Exposition of Chemical Industries from 83 in 1915, the first year, to 427 in 1921, warrants the expectation of the management that the exhibitors at the 8th Exposition on Sept. 11-16 at Grand Central Palace, New York City, will total 450, 400 already having contracted for space.

The educational features will be on a greater scale than have prevailed heretofore, embracing addresses by prominent men identified with the various branches of chemical manufacture, motion pictures of industrial subjects in the evenings, and in the afternoon meetings of industrial and commercial organizations. Among the last mentioned, the Technical Association of the Pulp and Paper Industry, Synthetic Organic Chemical Manufacturers Association, American Ceramic Society, Salesmen's Association of the American Chemical Industry, and the Technical Photographic and Microscopical Society have arranged to take care of the program for one afternoon each.

Herbert Hoover has promised to address the Chemical Salesmen's Conference on "Standardization and What It Can Do for the American Chemical Industry."

Catalysis and Catalysts in Chemical Processes

By Hugh S. Taylor
Associate Professor of Physical Chemistry, Princeton University

MODERN theoretical chemistry in its conclusions with regard to the structure of atoms and molecules indicates a mode of differentiation of chemical reactions. The mechanism of processes involving ions, oppositely charged, is comparatively simple. It is safe to assume that every time a silver ion meets a chloride ion formation of silver chloride results and in aqueous solution, precipitation ensues when the solution becomes saturated with respect to the salt produced. Reactions between neutral molecules, on the other hand, are by no means so readily initiated nor is the mechanism of reaction so obvious. Even molecules which are oftentimes regarded as " unsaturated " display a marked stability.*

Ethylene and hydrogen in a clean glass vessel at ordinary temperatures are quite without action on one another. Apparently each molecule under such conditions is a sufficiently stable configuration of negative electrons surrounding positive nuclei that, without special measures, no rearrangement of the electron configurations results. The old method of disturbing the electron configurations of these molecules was to heat the gas mixture. Temperature brings about a more rapid movement of the electrons, positions of instability are more frequently produced, and, consequently, interaction between the two gases more often occurs. With the aid of a suitable catalytic agent, this effect of increased temperature may be secured at ordinary temperatures. It is only necessary in this case to pass the cold gas mixture over a catalyst composed of nickel obtained by low temperature reduction of nickel oxide. It may be shown that the effect of the nickel is probably to cause, by temporary association of the catalyst with the gas molecules in question, a momentary rearrangement of the electron configuration around the nuclei of the molecules and the consequent production of a higher order of instability in the molecule than normally obtains in the gaseous system, at the given temperature, in the absence of the catalytic agent.

Role of the Catalyst Possibilities of Its Use

The rôle of the catalyst, therefore, is mainly in that realm of reactions occurring between non-ionized molecules. A moment's thought will show that this includes practically all types of chemical reactions. The ionic reactions are the least affected by catalysts though, even in such, catalytic influences have been found. The influence of the solvent medium is possibly catalytic. Attention may be drawn by way of example to the catalytic influence of manganese sulphate in various titrations with potassium permanganate.

The possibilities of use of the catalyst are legion; in gas reactions, involving oxidation, reduction, halogenation; in the reactions of organic chemistry, hydrolysis and dehydration, substitutions, hydrogenations, dehydrogenations and oxidations, whether homogeneous or heterogeneous, in gas-solid and gas-liquid systems. The accelerating influence of manganese dioxide on the decomposition of potassium chlorate shows, too, that one solid may markedly influence the reactivity of another solid. Certain electrochemical processes involving cathodic or anodic reactions are modified as to rate by the presence of catalytic agents. The activity of the enzymes in biochemical processes is also frequently catalytic in nature. Finally radiation, in one or another of its varied forms, whether as light, ultraviolet, visible or infra-red, or as X-rays or as the radiations from radioactive materials, may also function in a catalytic manner.

In all such processes the rôle of the catalytic agent is that of an intermediary, accelerating, or in some cases retarding, the operation of reactions which would normally occur, though at differing rates, in the absence of the catalyst. The accelerating or positive catalysts are those with which the chemist is normally concerned. Occasionally, as in the use of such a substance as acetanilide to stabilize hydrogen peroxide solutions, negative catalysts or retarding agents are utilized. In certain reactions one of the reacting substances or one of the products of the process is a catalyst for the original reaction. Such cases are termed auto-catalysis.

Thus the decomposition of silver oxide to yield oxygen and silver is catalyzed by the finely divided metallic product. A reaction which may initially be quite slow will in such cases gather momentum as the auto-catalyst is produced.

The modification of reaction rate which a true catalyst produces must be attained without change in the chemical form of the catalyst on completion of the reaction cycle. Its participation in the process as an intermediate compound is not excluded; indeed, for many homogeneous catalytic processes it seems necessary to assume the formation of such intermediate compounds. Nevertheless, a true catalytic agent must be regenerated in its original chemical form when the catalytic operation is complete. This being so, it is evident that catalysts also will be characterized by their operation in small concentrations for promotion of reaction between large quantities of the interacting substances.

Thus, some recent figures[1] indicate that one square inch of platinum gauze, 0.003 wire and 80-mesh, acting as a catalyst in the oxidation of ammonia, gives a yield of six pounds of nitric acid per day. For the present, also, it seems safer to assume that the catalyst promotes the establishment of the same equilibrium as normally would prevail in the absence of a catalyst. It is true that this viewpoint has been contested vigorously from several quarters in recent years. As yet, however, no unequivocal case of a shift in equilibrium caused by a catalyst has been brought forward, while there are many cases in which the reverse is true.

Physical Changes of the Catalyst

While the catalyst remains unchanged chemically on completion of the process, the same does not hold true of its physical state. Indeed, in many cases of heterogeneous catalytic reactions the solid catalyst shows marked physical change. The active catalyst is normally a porous, amorphous material and, in process of activation, catalysts tend to assume this form. Manganese dioxide, originally coarsely crystalline, will be found to be an amorphous powder after having catalyzed the decomposition of potassium chlorate. The change is most strikingly manifested in the microscopic examination of platinum gauze before and after use in the oxidation of ammonia. The gauze is converted from a

---

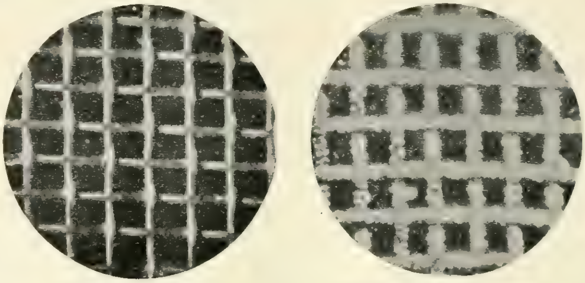
*From a paper presented at a meeting of the Section of Physics and Chemistry of the Franklin Institute, Philadelphia, Pa., *Journal of the Franklin Institute*, July, 1922.

[1] [illegible]

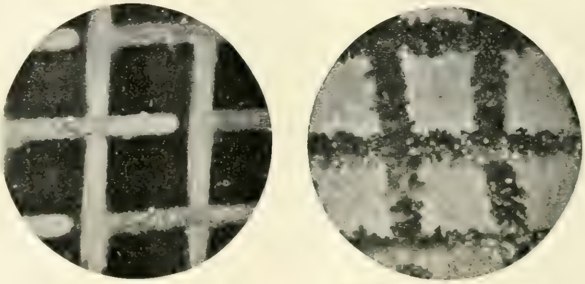
smooth plane-surfaced wire to a corrugated pitted material. This is shown in the accompanying figure. Similar changes in physical form are shown by silver gauze when used for the catalysis of hydrogen-oxygen mixtures.

Principles and Methods of Catalytic Investigation

There appears to be a fairly general impression that the investigation of a catalytic process is a somewhat random occupation and that the discovery of a catalytic agent is a fortuitous result of trial and error with indiscriminate selections from available compounds. It is true that a large number of catalysts have been discovered accidentally, or rather with little basic theory guiding the choice of material to be studied. With accumulation and systematization of facts relative to catalytic agents and the reactions they promote, the study of new processes, becomes, however, less and less empirical.



X24—Wire before use. *X24—Same wire after several weeks' use.*



X75—Wire before use. *X75—Same wire after several weeks' use.*

Microscopic view of platinum gauze before and after catalytic use in the oxidation of ammonia.

In the early days of organic chemistry, the student of a new compound doubtless applied such reagents as sulphuric acid or strong alkali quite empirically in the hope that he might gain the desired information relative to his material. Today, as a result of accumulated experience he applies these and other catalytic agents consciously, with full knowledge of the normal reactions which they promote. In the same way, the coördination of knowledge in reference to catalytic agents and the reactions they assist gives to the catalytic chemist of today more deliberate and purposeful methods of work.

A glance at the accompanying table of the more important industrial catalytic reactions classified as to type of reaction and as to type of catalyst employed will suggest the method of attack upon a new catalytic problem. It will be clear that the first stage in the investigation is a determination of reaction type, whence the probable type of catalyst will follow.

The trained catalytic chemist would spend little time investigating a hydrogenation process using catalysts which normally catalyze, say, halogenation or dehydration. Each class of reaction has its own class of catalytic agent and each of these classes may similarly be circumscribed as to members. Thus, for example, it may be seen that as catalysts for oxidation processes, oxides are an important class of catalysts. Of the oxide class, however, it is remarkable that only a limited number function at all prominently as catalysts. The oxides of well-defined stability are conspicuously absent. The oxides of the alkali metals, to a less extent those of the alkaline earths, definite irreducible oxides such as magnesium oxide and aluminum oxide, are not frequently to be found among the oxide catalysts of oxidation. On the other hand, the unstable oxides such as those of iron, copper, manganese, silver, vanadium, tungsten, molybdenum, uranium, chromium, cobalt and cerium are frequently to be noted in a systematic study of such oxide catalysts of oxidation.

It is well to remember that, in normal circumstances, a catalyst accelerates both the forward and the backward reactions of an equilibrium process. The catalyst of hydrogenation should therefore be, and is, frequently, the catalyst of dehydrogenation processes. Nickel assists the direct hydrogenation of benzene; it is also the catalyst for the dehydrogenation of cyclo-hexane. Since it has been observed, in the reduction of nitrobenzene by hydrogen in the presence of nickel, that the reaction may proceed further than the aniline stage and yield benzene and ammonia, it naturally suggests itself to the catalytic chemist that nickel will catalyze the removal of hydrogen from benzene and ammonia to yield aniline. This has been shown to be true[2], though the yields attained are exceedingly small.

Methyl Alcohol from Water-Gas

Correct appreciation of such principles and suitable correlation with known facts frequently result in the forecasting of suitable catalytic agents. There is at the present time in the development stage a catalytic process of immense industrial potentialities, concerning which details are as yet carefully withheld. The process involves the treatment of water-gas (H_2+CO) with catalytic agents to yield methyl alcohol. The reaction may be formulated by means of the equation $CO+2H_2=CH_3OH$. The process probably takes place through formaldehyde as an intermediate product which is then immediately hydrogenated to methyl alcohol. $CO+H_2=HCHO$; $HCHO+H_2=CH_3OH$. The essential reactions are hydrogenations and call therefore in all probability for reduced metals as catalysts. The knowledge that nickel, cobalt and palladium cause the hydrogenation of carbon monoxide to proceed to methane and water, $CO+3H_2=CH_4+H_2O$, seems to rule these catalysts out of court in the reaction under consideration. The knowledge that copper and platinum are incapable of promoting the conversion of carbon monoxide to methane brings them therefore prominently into consideration. The knowledge that

[2] Meyer and [illegible], Ber. 46, [illegible]

Classification of the More Important Industrial Catalytic Reactions

Type of Catalyst	Samples of Exemplification in Industrial Practice.
	Hydration and Hydrolysis
Acids	(a) Hydrolysis of glycerides, soap and candle industry, sulphuric, sulphonic (Twitchell reagent) acids as catalysts. (b) Hydrolysis of starches and wood cellulose to yield sugars. Sulphuric, hydrochloric, sulphurous acids as catalysts. (c) Hydrolysis of esters using acids. (d) Hydration of acetylene to yield acetaldehyde. Various acids as catalysts.
Alkalies	(a) Hydrolysis as in (a) and (c) above. NaOH, KOH, $Ca(OH)_2$, MgO, ZnO as catalysts.
	Dehydration
Acids	(a) Manufacture of ether. Sulphuric, sulphonic and phosphoric acids as catalysts. (b) Esterification processes. Hydrochloric and sulphuric acids as catalysts.
Oxides	(a) Manufacture of ethylene and unsaturated hydrocarbons. Clays, Al_2O_3, SiO_2, TiO_2 as catalysts.
	Halogenation
Non - metallic elements	(a) Chlorination of carbon disulphide, carbon - monoxide and hydrocarbons. Carbons, iodine, sulphur as contact agents.
Chlorides	(a) In synthetic organic, chemistry. $AlCl_3$, $FeCl_3$, $SbCl_5$, $SnCl_4$, $ZnCl_2$, $HgCl_2$, as contact agents.
	Oxidation
Metals, especially the platinum metals	(a) Contact sulphuric acid process using finely divided platinum on a suitable support. (b) The oxidation of ammonia using a platinum gauze. (c) The preparation of formaldehyde, using copper or silver (see dehydrogenation).
Oxides	(a) Lead chamber process, employing a gaseous catalyst, oxides of nitrogen. (b) Contact sulphuric acid manufacture with iron oxide catalyst. (c) Chance-Claus process of sulphur recovery. Oxide of iron as catalyst. (d) Purification of illuminating gas. Hydrated oxide of iron as catalyst. (e) Surface combustion processes, refractory oxides as catalysts. (f) Oxidation of hydrocarbons, V_2O_5, MoO_3, WO_3, etc., as catalysts.
Salts	(a) Deacon chlorine process, copper chloride as catalyst. (b) Oxidation processes in the dye industry. Mercury and copper salts. (c) Oxidation of aldehydes, manganese salts as catalysts. (d) Drying of oils. Metallic soaps as accelerators.
	Hydrogenation
Metals	(a) Hydrogenation of oils. Nickel and platinum as contact agents. (b) Fine organic chemical industry, *e. g.*, synthesis of cyclo-hexane, reduction of organic compounds. Nickel as catalyst.
Oxides	(a) Hydrogenation of oils, nickel oxide as catalyst (especially at elevated pressures).
	Dehydrogenation
Metals	(a) Cracking of oils, nickel, copper, iron, aluminum as catalysts. (b) Dehydrogenation of alcohols, copper, silver and nickel as catalysts.
Oxides	(a) Cracking of oils, Al_2O_3 and TiO_2 as catalysts. (b) Dehydrogenation of alcohols, ZnO, SnO, CaO and MgO as catalysts.
	Nitrogen Fixation
Metals and metal - oxide mixtures	(a) Ammonia synthesis. Reduced iron, iron-molybdenum, iron-pot ash, and nickel-sodium as contact agents. (b) Cyanide formation. Reduced iron as catalyst. (c) Arc process of oxide of nitrogen formation. Metal electrodes as negative catalysts. (d) Nitride formation (Serpek process). Iron, copper, chromium, molybdenum, etc., as catalysts

copper is an active agent for the dehydrogenation of methyl alcohol to yield formaldehyde is additional evidence in favor of a trial of reduced copper as the catalyst. The information which would permit a test of such a forecast has not been disclosed but it should not long be delayed.

Determination of Most Favorable Conditions

A prior knowledge of the equilibrium conditions in the reaction to be catalyzed is an extremely valuable asset to the catalytic investigation. The technical success that has been attained in the contact sulphuric acid process, in the synthesis of ammonia and in the water-gas catalytic process of hydrogen manufacture for ammonia synthesis is based, in no small measure, on the equilibrium data accumulated by the Badische Anilin and Soda-Fabrik and associated investigators. These data define the optimum working conditions and facilitate the definition of working officiencies. These processes are at once classical examples of the contributions of catalysis to modern chemical industry and justification of the claims of theoretical science upon the support of the technical man.

In the absence, however, of exact equilibrium data, useful approximations may be made. The Nernst approximation[3] formula is especially useful and applicable. Nor can the conclusions of thermodynamics be neglected by the catalytic chemist in the definition of the operating conditions. Thus, in the reaction already discussed, $CO+2H_2=CH_3OH$, the reaction is exothermic. Low temperatures therefore favor the formation of methyl alcohol. Pressure facilitates its production in higher concentration at a given temperature. The upper limit of temperature for economically feasible yields may be computed with the aid of the approximation formula of Nernst.

Form of the Catalyst

Catalyst Support Materials

In homogeneous media the form of the catalyst is not important. A gaseous catalyst in a gas reaction or a dissolved catalyst in liquid systems has a definite and readily reproducible form. In the last analysis the acceleration or retardation caused by the catalyst is, in such systems, proportional to its concentration. This point is not infrequently forgotten owing to deviations from strict proportionality between reaction velocity and presumed concentration. Thus, as is well known, the catalytic action of acids in hydrolytic processes is not strictly proportional to the molar concentration of the acid catalyst. Such abnormalities have been the object of much study. Better concordance is obtained between hydrogen ion concentration and catalytic activity, but even there the proportionality is not an exact one.

---

[3] See Lewis, "System of Physical Chemistry," vol. ii, 1919, pp. 75 and [illegible]

Various reasons for this fact have been adduced, none completely satisfactory. By some it is urged that the undissociated acid molecule is catalytically active; by others that only non-hydrated hydrogen ions are catalytically active. Others define the catalysis in terms of the thermodynamic "activity" of the ions. Concerning all such, whatever the real explanation, it may be remarked that the catalysis in homogeneous media will be proportional to the active mass of the actual catalyst or catalysts, since there may be several present.

If the catalytic reaction be heterogeneous, the form of the catalyst becomes immediately a matter of first importance. That this is so in liquid-liquid systems may be shown in reference to hydrolytic processes. In homogeneous media it is well known that the reaction velocity of hydrolysis of esters is approximately proportional to the hydrogen ion concentration. In heterogeneous systems, however, the acid strength is not the principal factor.

Thus, hydrochloric acid is not so good an agent for the splitting of fats as the sulphonic acids, though these acids are approximately of equal strengths. The activity of the sulphonic acids is modified profoundly by the nature of the hydrocarbon grouping, as was early shown by Twitchell. The Twitchell reagent, naphthalene stearo-sulphonic acid or a similarly constituted acid, undoubtedly owes its efficiency as a hydrolytic agent in the splitting of fats to the fact that the molecule of acid catalyst is orientated, so that the polar sulphonic grouping is in the aqueous medium, while the hydrocarbon nucleus is within the glyceride oil. This is a splendid instance of technical development far in advance of scientific theory. It will be seen that the concept of orientation of molecules as a necessary feature of contact action is of quite recent origin.

Solid Catalysts

In the case of solid contact agents, the problem of form is equally important. The striking feature common to most of the contact catalysts is their porous or finely divided structure. The successful contact agent is characterized by this amorphous nature of the material. As already emphasized in this connection, with platinum and silver gauze catalysts, the preliminary phase of activation is accompanied by a change in the surface form of these metals to a roughened surface with which catalytic activity is high. This change may operate favorably to catalysis in two ways. It may change the normal spacing of the atoms in the metal surface to one more favorable for the adsorption of the reacting gas molecules in such configurations as are conducive to interaction.

In addition, however, the activation may result in the production of a larger number of atoms in the surface layer, with electrons in a more or less unsaturated or free condition unshared by neighboring atoms and able, therefore, to enter into association with impinging molecules more readily than the symmetrically placed atoms in a non-catalytic surface. Evidence of this phenomenon is forthcoming from adsorption experiments[4] with catalytic agents in the Princeton laboratories. Nickel obtained by reduction at low temperatures (200-300° C.) shows high absorption for many gases. The extent of adsorption, however, is determined largely by the previous history of the catalyst. By submitting the catalyst to temperatures between 300-600° C. the nickel will slowly lose its adsorptive power, presumably by saturation of the free electrons of the nickel atoms with neighboring nickel atoms, which process is, of course, the phenomenon of crystallization. It is undoubtedly this same phenomenon which accounts for the slow loss activity of a catalyst with prolonged use, even though reactants of the utmost purity be used.

The loss of adsorptive power by nickel, parallels the variation in catalytic power of this metal with variation in temperature of preparation. Kelber[5] showed that nickel oxide *per se*, when reduced at about 300° C., gave a moderately active catalyst, but when reduced at 450° C., gave a product of but feeble activity. The conclusions have recently been checked by Armstrong and Hilditch, who show that reduction at higher temperatures gives rise to considerable shrinkage in the volume of the catalyst.

This shrinkage and loss of catalytic activity can be largely suppressed if the active material is spread upon an inert support. In this way, for example, it is possible to produce a 500° C. a nickel catalyst supported upon kieselguhr, of greater activity than from precipitated nickel hydroxide, by reduction at 300° C. The kieselguhr, which does not shrink on heating, almost wholly determines the bulk of the product and the nickel adhering to the support can only coalesce with much greater difficulty. The factors in these several cases are well set forth in the following chart, due to Armstrong and Hilditch:

	Source of Reduced Nickel			Reduced Nickel		
	Density	Apparent Volume c.c.	Temperature of Reduction	Density	Apparent Volume c.c.	Catalytic Activity
Powdered fused oxide	6.96	0.35	500° C.	8.14	0.52	None
Precipitated hydroxide	5.41	0.87	(300° C.)	7.85	0.83	Fair
			(500° C.)	8.18	0.56	Very little
On kieselguhr	1.63	3.22	500° C.	1.85	2.67	Very active

Recent measurements by Mr. A. W. Gauger in the Princeton laboratories have shown that the adsorption of nickel, *spread on kieselguhr*, is the same when the catalyst is reduced at 500° C as when reduction is effected at 300° C. in sharp contrast to the behavior of "unsupported" nickel. Concordance is, therefore, shown between these adsorption measurements and the catalytic studies of Kelber, Armstrong and Hilditch. It has been shown, further, that the extent of adsorption of gas by unit weight of metallic catalyst is enormously increased when the catalyst is spread on a porous support. Thus, one gram of nickel spread on diatomite (Nonpareil) brick adsorbs the quantities of hydrogen listed in the tables below, where also are to be found corresponding figures for nickel obtained by reduction of coarsely powdered nickel oxide, prepared by ignition of the nitrate.

	C.c. Hydrogen Gas Adsorbed per gram Ni at							
	25°	80°	175°	184	200°	218°	240	305° C.
Ni without support	0.69	0.63		0.53		0.48		0.36
Spread on diatomite			[illegible]		[illegible]		[illegible]	

---

[4] [illegible] 43, [illegible]
[5] [illegible] 49 [illegible] (1916)

Our researches have enabled us to show also a striking parallelism between adsorptive capacity and catalytic activity in a variety of cases, though this is not the only factor involved, as will be shown later. Nevertheless, the results obtained, and those cited previously, demonstrate the important part which the catalyst support material may play in successful catalysis. With expensive catalytic agents, as, for example, platinum, the use of a support is frequently indispensable.

A variety of materials has been employed as catalyst supports. Platinum is normally employed in the contact sulphuric acid process, either on asbestos fibre or on calcined magnesium sulphate, the platinum being generally sprayed in the form of the chloride on the suitably prepared mass. Mention may also be made of pumice, glass wool, silica fibres, fibrox, various porous siliceous materials such as fireclay, alundum, unglazed porcelain, kieselguhr either in powder form or bonded into brick, charcoal, various porous oxides and anhydrous salts.

It is interesting to record metallic aluminum as the most recent of catalyst support materials, now being employed as a support for metallic oxides in the air oxidation of hydrocarbons[6] and in the catalytic conversion of acetic acid to acetone[7], using lime as catalyst. The metal support facilitates thermal equilibrium in the catalyst system. It is employed in a granular form, obtained by allowing the molten metal to cool slowly in trays, the mass, meanwhile, being vigorously shaken.

Preferential Catalysis

An interesting phase of the general subject of catalyst is that of preferential catalysis. It is possible, by suitable choice of a catalytic agent, to secure the preferential progress of a given gas reaction in presence of other gases which are also capable of undergoing the same reaction. A familiar example is the preferential oxidation of hydrogen sulphide to sulphur and water,

$$2H_2S + O_2 = 2H_2O + 2S,$$

in presence of other gases, such as carbon monoxide, hydrogen and methane. This is secured in the purification of illuminating gas by passage of the gas admixed with small quantities of air over a reactive hydrated oxide of iron as, for example, bog iron ore at ordinary temperatures.

Another important example of recent industrial development, is the Harger-Terry process of preferential combustion of carbon monoxide with oxygen in presence of hydrogen, a process which has now been applied to the elimination of small quantities of carbon monoxide from hydrogen prepared by the steam-iron process.

A study of the mechanism of this process of preferential combustion from the standpoint of adsorption has recently been made at Princeton by Dr. A. F. Benton. The normal agencies for such preferential catalysis are certain metallic oxides, preferably obtained by precipitation of the hydroxides and low temperature removal of the water. Among the more important of such oxides are those of copper, iron, manganese and cobalt. Experimental test has shown, in all such cases, that the oxides adsorb carbon monoxide to a very considerably greater extent than they adsorb hydrogen, which, in most cases, is only taken up by such oxides to a negligible extent. It is clear, therefore, why, even when the carbon monoxide is present in small percentages in hydrogen, its reaction at the oxide surface preponderates over that of the hydrogen gas.

Promoters

The reactivity conferred on a molecule by reason of the proximity of a molecule of decomposition product can also be secured by admixture of the reacting species with a suitable foreign substance. Doubtless it is oftentimes this effect which accounts for the enhanced activity of a catalytic agent when admixed with small amounts of a suitable foreign substance.

Such admixtures are termed catalyst "promoters" and their tutilization in technical catalysis is a growing development of the catalytic art, as the appended table of examples will show. A summary of the principal examples of promoter action has already been compiled by Pease and Taylor.[26] The mechanism of promoter action has received but little study. It is apparent, however, that a suggestive list of experimental investigations can be put forward on the basis of activity at an interface. It can readily be seen that if added substances increase the instability of decomposable oxides and their reducibility, the general level of reactivity of the molecule under such circumstances should be consistently greater than that of the single oxide in absence of such added substances.

Industrial Examples of "Promoter" Action

Catalyst.	*Promoters Used or Suggested.*
CONTACT SULPHURIC ACID PROCESS	
Burnt pyrites	Oxides of Cu, V, Ur, Cr, Ni, Co, Al, Be, Zr, Zn, Ce, Th and Di
AMMONIA OXIDATION	
Oxide of iron	Oxides of Cu, Ca, Bi, Ce, and Cr
Platinum	Oxides of Pb and Te
DEACON CHLORINE PROCESS	
Cuprous chloride	Chlorides of several elements
REMOVAL OF SULPHUR COMPOUNDS FROM GASES	
Iron oxide	Oxides of Cr, Ce and Th
PRODUCTION OF FORMALDEHYDE	
Various metals	Metallic couples
OXIDATION OF ANILINE TO ANILINE BLACK	
Copper sulphate or Vanadium chloride	p-diamine or p. amidophenol
OXIDATION OF NAPTHALENE	
Mercuric sulphate	Copper sulphate
$CO + H_2O \quad CO_2 + H_2$	
Iron oxide	Oxides of Cr, Ni, Al, Ce, Th, Zn, Pb, Ur, Na, Cu, Ag and Cu metallic couples
$2CO + H_2 \text{ excess} + O_2$	
Iron oxide	Oxides of Cr, Ce, Th, La and Al
$2CO_2 + H_2 \text{ excess} + O_2$	
Copper oxide	Oxides of Ce, Ag and Mn
HYDROGENATION OF OILS	
Reduced nickel	Reduced copper, iron
AMMONIA SYNTHESIS	
Reduced iron	Reduced Mo, W, Co, Ni, Ur. Traces of alkalies

Catalyst Poisons

The inhibiting effect of small quantities of foreign bodies on the activity of a catalyst has yielded satisfactorily to investigation. Poisons may be either permanent or transitory. Thus, silicon compounds, present in the ammonia-air mixture used in the oxidation of ammonia in contact with platinum gauze, are oxidized to silica, are deposited in part on the gauze and destroy its activity by covering up the platinum surface. The poisoning is permanent.

---

[6] The Barrett Co., Edgewater, N. J.

[7] Stockholms Superfosfat Aktiebolaget, Br. Pat., 1921.

[26] [illegible] Phys. [illegible] 21 [illegible].

Hydrogen sulphide and sulphur compounds transform an iron catalyst in ammonia synthesis and a nickel catalyst in hydrogenation processes to the corresponding sulphides whose activity is zero. The effect of the sulphur compounds is cumulative and it is necessary to regenerate a catalyst so poisoned by suitable means. In the case of an iron catalyst poisoned by sulphur, it is necessary to oxidize the sulphide and then regenerate the metal by reduction of the oxide. All cases of permanent poisoning require such a renewal of the contact mass before original activity is regained.

Transitory poisons in gas reactions are most generally to be explained on the basis of preferential adsorption of the poison from the gas mixture, even though this latter is present in only minute quantities. Thus, water vapor is a transitory poison in ammonia synthesis in presence of an iron catalyst. It is probable also that water vapor is the real poison in the case of oxygen and carbon monoxide in ammonia synthesis in presence of iron, since both these gases undergo quantitative transformation, to water vapor and to methane and water vapor respectively, under the conditions of the synthetic process.

All these poisons are, however, transitory in their action since, after the removal of the harmful constituent, provided the action has not been too prolonged, the original activity of the catalyst is restored. Water vapor is doubtless tenaciously held by reduced iron even at the working temperature of ammonia synthesis, about 500° C., and when present in only minimal concentrations. It should be noted that a poison may be both transitory or permanent according to the catalyst used. In the case of ammonia synthesis, using uranium carbide (which changes to nitride) as catalyst, water vapor, oxygen, and carbon monoxide are permanent poisons. They convert the nitride to an irreducible uranium oxide, catalytically inert. It is this factor that has militated against the technical use of the otherwise very excellent uranium compound as a catalyst in ammonia synthesis.

Metallic catalysts are occasionally poisoned by other metals. Lead, mercury and zinc are marked catalyst poisons for platinum in a variety of catalytic actions. Mercury vapor is a powerful catalyst poison to copper and nickel as hydrogenation catalysts.

Systematic investigation of the rôle of the poison in the case of palladium and platinum catalysts has been carried out in the last two years by Maxted.[27] The decrease in activity caused by the poisons, lead, mercury, sulphur, arsenic and zinc, is directly proportional to the concentration of the inhibitant from zero concentration up to that producing practically complete inactivity. The occlusive power of palladium for hydrogen varies directly as the amount of sulphur present as inhibitant. The amount of poison (in this case lead) required to reduce the catalytic activity to one-half is very much less than that which reduces the occlusive power to half its original value. This may be explained by the fact that, while occlusion is not confined to the surface, catalysis is a surface phenomenon. With metals showing adsorption without marked occlusion there would doubtless be complete identity between loss of adsorptive power and loss of catalytic activity.

Chemical Warfare Preparations

The War Department will continue its experiments in the manufacture of poison gases, regardless of the treaties growing out of the conference for the limitation of armaments which was signed by the plenipotentiaries assembled at Washington on February 6, 1922, and was ratified by the United States Senate on March 2, 1922. The Government arsenal at Edgewood, Md., will be maintained as a laboratory experiment station, and the best talent will be utilized to develop ideas in chemical warfare and in poison gases, although they will not be manufactured in quantity.

The Government's decision to go ahead with its chemical experiments is made despite the conviction of every official, including the President and the Secretary of War, that the use of gas in warfare is an offense against civilization. It is believed the agreement reached at the Washington conference has been a move in the right direction. But it is regarded as only a step. The viewpoint entertained by the War Department, that experimentation in new gases should be continued, is held by the military affairs committees of both Senate and House and is reflected in the appropriation contained in the army bill for this purpose.

In a War Department order issued July 12, it is provided that limitations will be observed in connection with the procurement, design, research, development and supply in chemical warfare materials. It is further provided in the order that the investigation, development, procurement, manufacture or supply of poisonous gases for the present will be limited strictly to the amount necessary for the research and development of gas defense appliances. The filling of all projectiles and containers with poisonous gas will be discontinued except for the limited number needed in perfecting gas defense appliances.

In the action of George T. Rogers against Joseph H. Adams and the Texas Co. for profits accruing from the ownership of a 40-per cent. interest in the Adams' patented process of oil refining which Adams sold to the Texas Co., after having disposed of this interest to Rogers, decision has been handed down confirming Rogers' ownership, from which appeal will be taken in the New York courts. Should it be decided that Rogers is entitled to royalties on the 40-per cent. interest in Adams' patents, which he acquired in 1907 for a loan of $5,000 made to Adams, the Texas Co. will recoup itself, to the extent to which Rogers may recover from it, through royalties it pays to Adams.

The Texas Co. helped Adams perfect his process and acquired all interest to it with provision for royalties to Adams. While Rogers failed to file claim in patent office, as is the practice, of his 40-per cent interest, the trial court held that the Texas Co. could have found out this situation by inquiry, and confirmed Rogers' claim. This is the decision which will be appealed. Rogers had previously assigned his 40-per cent interest to the Standard Oil Co. of N. J.

The decision is not expected to affect the agreement entered into last fall between the Texas Co. and the Standard Oil Co. of Indiana by which both are permitted to use and license each other's refining processes. The Indiana Co.'s process is the Burton while the Texas Co. has Adams and Holmes-Manley.

W. R. Smith, assistant general manager, Clinton Corn Syrup Refining Co., Clinton, Iowa, has been made general manager to succeed A. H. Kursting, deceased.

---

[27] [illegible] 117, [illegible] 119, [illegible] 119, [illegible]

David Wesson

David Wesson

Technical Director, Southern Cotton Oil Company

Prominent in the promotion of the profession of Chemistry. As a research chemist and industrial organizer, he created a new industry out of cottonseed oil

CHEMICAL AGE

Volume 30
Number 7

July
1922

A Consolidation of
The Chemical Engineer
and Chemical Age

EDITORIAL

IN the framing of the issues between the Government, as represented by the present administration, and the Chemical Foundation, Inc., the outstanding questions appear to be: To whom do the patents rightfully belong; was the consideration sufficient; was there violation of a trust?

The final disposition of the Foundation patents, in the inevitable judicial determination of their ownership, and the outlook for the domestic organic chemical industry, in view of the Senate's rejection of the embargo provision, are surrounded with such uncertainty as well as may spread dismay not only among those who have participated technically and financially in the establishment of the industry, but among the people who have come to know the place of chemistry in our economic system.

Perusal of the article on page 321 leaves the merits of the contention, as publicly discussed prior to the action in equity against the Foundation promised by the Alien Property Custodian in co-operation with the Department of Justice, clearly with the Wilson regime which it appears to some the present administration would seek to discredit. We must eliminate from our consideration of the future of the Foundation and of the fortunes of the enterprises predicated on its functions, the machinations of politicians and the intrigue of those who would sacrifice the national welfare to the benefit of a former enemy, for motives behind a charge disappear in a judicial consideration of the facts alleged.

These facts the world knows and are ably presented by Mr. Garvan who, in his leadership to conserve the advantages gained in the failure of the unholy scheme to tie the world to a Teutonic chariot, has the confidence and encouragement of every patriot.

THE preventable wastes of industry pale into insignificance besides those incident to the civil warfare of strikes. A group defies Government in its rejection of the decree that it shall not be a privileged class supported by tribute upon all who labor. Operatives in the most wasteful American industry demand that war-time wage and production methods shall persist in a period when cutting to the bone is compelled that taxes may be paid and goods sold at a price which, in the encouragement of production and employment, will make taxation less of a burden.

Today coal miners and railroad shop men are affronting American Government and stifling American industry in the vain hope that class welfare lies that way. Have we not, in the arrogance of organized labor and its seditious leaders, an illuminating analogy in the rebellion of cancerous growth to the economy of the human body?

The nation must exert its power of internal self-defense against those who, by the denial of fuel and transport, would starve and freeze the people in the maintenance of class privilege.

HENRY FORD'S proposal for the purchase and lease of the Muscle Shoals properties was rejected in a vote of 9 to 7 by the Senate Committee on Agriculture; rejection of other proposals was not dignified by a roll call. Operation by a government-controlled corporation also was rejected in a vote of 9 to 5. Senator Ladd, who favored unconditional acceptance of Ford's offer, was authorized to submit a minority report, as also was Senator Norris as regards the government-controlled corporation plan, action on neither being expected during the present session.

With this disposition of an attempt at personal aggrandizement at the people's expense and to the demoralization of a great industry, under the guise of cheap fertilizer for the farmer, the Congress now is free either to maintain the property in a stand-by condition as at present, or to sell it and to lease the power site to the highest responsible bidder, or to carry it forward as any other river and harbor improvement.

THE scientifically trained man, as a class, notoriously is not only not a business man but is deficient from the nature of his training in that kind of executive capacity required in public affairs and without taste for its development. We have explained that it is only when the man is something more than a chemist does he measure up to responsibilities that rest upon contact with his fellows and the management of men.

The one great reason for the poor display that chemically trained men make of themselves in civic affairs is grounded in the principle that if a man can't do much for himself or his class it is futile to look for him to do much for others in the public service in which it is incumbent upon us all to participate.

Recognition has been accorded to the chemist in his fundamental service to lessen the pressure of population upon the soil by increasing the variety and cheapness of its products, but in service for which he does not qualify it is useless to expect recognition, and of equal inutility to confirm what every one interested in chemists and chemistry already knows. That he does not identify himself with the civic affairs of his community is greatly to be regretted, for in failing so to do the chemically trained man is neglecting the great responsibility of the educated man in a democracy at a time when the integrity of our institutions is threatened by the hordes of mediocrity.

CHEMICAL organization is for the primary benefit of the members of the organization and not to contribute to facility of control by men who make such work a profession. In their service as instruments of education, chemical organizations will be multiplied so long as the educative need exists. The contention that one organization under centralized control of chemical politicians can meet all the requirements of the chemists' welfare is disproved by the formation in recent years of numerous satellite organizations and of the growth of cliques and of secret association within the central body.

This latter aspect of chemical segregation, repellent to ways of thinking under a form of government dedicated to equality of opportunity, is the outstanding condemnation of a system determined to make a scientific society the sole repository of incompatible functions which demand for satisfactory performance such separation as will provide unconstrained fields for distinctive aims and aptitudes.

No class of men needs the experience and advantage to be derived from soundly conducted economic organization so much as chemically trained men, for not only has their academic education been barren of cultivation of ways and means of self-interest, but their low professional status in practical affairs is the direct result of individual timidity and reluctance to do collectively what all recognize should be done. Instead of encouraging the correction of this state of mind, this characteristic of chemically trained men is capitalized to create subserviency to a system wherein the improbability of correction of conditions complained of has been fully explained and frequently demonstrated.

SOME sage has said that the consciousness of being well-dressed is of greater moral support than the consolations of religion. Let us pursue the wisdom of this observation into the maze of unsatisfactory conditions that surround the work of the practitioner of chemistry, in the hope that we may find an explanation of the chemically trained man's poor showing in the assumption of civic responsibilities, and a practicable means of instilling in the man that self-respect, that self-confidence and independence, which lie at the root of leadership.

The industrial worker is subject to no greater demoralizing influence than the fear of the loss of his job; this influence is greatest where the rate of pay is lowest and the worker's sensibilities are keenest, naturally so among the educated workers in industry. Every man likes to be well thought of and to encourage this impression when pride does not inhibit, to which the chemically trained man is no exception. Is not this influence a powerful deterrent to the chemist's assertiveness in public matters, the consideration of which would gain much from his participation?

To claim that the educated industrial worker in chemistry is a scientific man engrossed with the problems of his laboratory is both a poor and a wrong explanation for his neglect of civic responsibilities. Participation in public affairs, just as in scientific societies, is determined very largely by what the participants get out of it, the general drift in our system of government being to relegate the responsibility to those who need or can use in their business the contacts established. In the performance of these responsibilities the chemist would come in contact with men in comparison with whom he suffers in those attributes that contribute most to getting ahead. In these qualities in many respects the chemist, as a class, is a victim of arrested development.

Promotion of this stunted growth is the most important subject that can receive the attention of chemically trained men, which can be done most effectively by the economic professional organization dedicated to standardizing his capacity and advancing his professional status, unconstrained by the influence of a scientific society dedicated to the creation of conditions which the former organization would systematize and in a measure control. It is one thing to investigate the obvious and declare what everybody knows; it is another thing to seek to explain it and to suggest and encourage the means of its correction.

AS chemists we are the highly specialized product of a prolonged, intensive training in which is involved a sacrifice of ability to sell to the best material advantage what we know. CHEMICAL AGE believes acquirement of such ability can come only from experience but that it can be aided mightily by the service possible only from a professional organization dedicated to making the most out of the member—from an organization of his kind, in no way embarrassed by conflicting purposes, to which he can turn as a matter of right for service to be rendered as a matter of duty.

CHEMICAL AGE has instigated the widespread consideration of this subject, as regards which it is the only publication in American chemistry which is expressing the opinions of American chemists. This we have done with a fearlessness and capacity that have earned general commendation.

To ascertain numerically the opinions of American chemists on the desirability of a professional economic organization of chemically trained men, as has been discussed in these pages, CHEMICAL AGE has instituted a post-card vote and respectfully requests the thousands of recipients of these cards to indicate thereon their opinion and return same to this office for count and report. Please vote and mail the ballot.

U. S. Bureau of Mines and Trade Associations

Cooperation of Government Scientific Service with Trade Associations of the Brick and Tile Industries in the Promotion of Fuel Conservation

By R. T. Stull
Supervising Ceramist, U. S. Bureau of Mines

COOPERATION of the scientific service of the Government with trade associations in the promotion of production efficiency is evidenced by the work of the U. S. Bureau of Mines in conjunction with trade associations in the fields of common, face and paving brick and hollow building tile manufacture, in an investigation of the problem of reducing fuel consumption and time in the burning of brick and hollow building tile kilns.

To the joint fund of $10,000 per year, $7,500 of which is available for field work, provided by the trade associations in the industries mentioned the Bureau of Mines in the prosecution of its fuel conservation work allotted more than twice the amount subscribed by the four associations.*

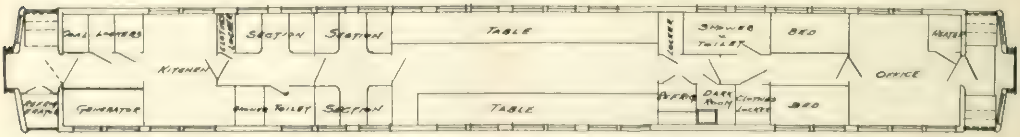
Left to Right—W. F. Rue, A. R. Mumford, P. S. Bachman, Robert Lunger, E. B. Baker and R. C. Zehm

Details of the Investigation

On the kilns investigated, a careful study is made of the burning conditions. The amount of fuel used is determined, sampled and analyzed and its calorific value determined. The rate and end of water-smoking and rate and end of oxidation of the product during the burn are also determined. Where coal is used, the ash is weighed and analyzed. Temperature measurements are taken hourly at different points in the kiln. The temperature, draft-gauge readings and analysis of the flue gases going out the stack are determined at intervals. The temperature of the walls and crown at different points and different depths are also made. The atmospheric conditions as to temperature, humidity of the air, velocity and direction of the wind are also recorded. In fact all the data that can be gathered are recorded. From the data so obtained, careful heat balances are made and the amount of fuel per ton of ware burned determined and a record kept of the quality of the product obtained.

Two tests are made on the same kiln at plants where such tests are in progress. For the first test the kiln is set and fired under normal factory conditions. A careful study is made from the data obtained on the first test, and such changes in the setting and firing of the kiln are made as a result of such study will warrant, and a second burn is made.

In some plants it has been found that their burning conditions are very good and very little or no time has been saved under such conditions. The reports on the results obtained under these conditions will be most valuable for the brick and tile manufacturers in that they will show what is being done under good burning practice. However, in the majority of cases, substantial savings in time and fuel have resulted. From 12 per cent to as much as 38 per cent of the fuel and from 10 per cent to more than 50 per cent of the time required for burning have been saved.



Floor plan and exterior view of the U. S. Bureau of Mines laboratory car "Holmes," and the personnel of its scientific staff engaged in the investigation of the problem of reducing fuel consumption and time in the burning of brick and hollow tile

The Traveling Laboratory

In order to facilitate the work the Director of the Bureau assigned the use of the laboratory car "Holmes," which serves as living quarters and work shop for the crew. A cook was secured and the car put in commission January 1, 1922. In this work the Fuel Division of the Bureau of Mines is cooperating with the Bureau's Ceramic Experiment Station, Columbus, Ohio, and, accordingly, of the crew, consisting of 6 men, three are from the Ceramic Experiment Station and three from the Fuel Division of the Bureau of Mines.

---

*[illegible] of the Director of the U. S. Bureau of Mines.

The car has an office at one end with writing desk and typewriter desk, bookcases and filing cases, two permanent beds with bureau drawers beneath and pullman berths above, two large clothes closets, two toilets and shower baths, a dark room for developing photographs, a laboratory, drafting room and work shop, three pullman seats which serve as the dining room and which can also be made up into 6 berths, a kitchen well equipped with culinary utensils, and a large refrigerator and ice box. The electrical equipment consists of a direct connected gas engine and generator for charging the storage batteries consisting of 55 cells of 110 V. For the water system there are storage tanks of 510 gallons capacity provided with an automatic air pump for maintaining pressures on the water system, and the car is heated by the Baker hot water system.

The equipment used on the car consists of thermocouples, potentiometers, recording galvanometers for continuously recording temperatures, gas analysis apparatus, porosimeter, electric drying oven, scales and balances, thermometers, anemometers, and an electric welding outfit for repairing thermocouples. The equipment also includes the necessary tools for doing simple repair work, drafting boards and instruments, planimeter, cameras, printing frames, adding machine, typewriter, and phonograph.

The work on the kiln investigation began in September, 1921. At that time, the crew experienced considerable difficulty in finding suitable living quarters. At one plant it was necessary to walk a distance of 2½ miles from living quarters to the plant. The car has been of the greatest value in facilitating the work in that as soon as it is parked on the switch at the plant where the test is to be made, the crew is ready to go to work immediately. It has also been found that the crew can be maintained at a lower cost by using the car than to conduct the work in the old way without it.

The Situation in British Dyestuffs Manufacture

THE publication July 1 of the report of the British Dyestuffs Corp, Ltd., for the year ended October 31, 1921, showing a net loss of over £1,000,000 directs attention to the status of the English synthetic organic chemical industry, for the success of the industry as at present constituted depends upon the fortunes of this corporation in which the British government holds a substantial interest. The British Dyestuffs Corp., Ltd., is the result of the amalgamation in May, 1919, of British Dyes, Ltd., and Levinstein, Ltd., under a plan to develop a domestic organic chemical industry independent of German sources from which prior to 1914 Great Britain's supplies of synthetic dyes chiefly had been drawn. With a total issued capital of £9,194,990, divided among 16,000 shareholders, of which the Government holds £1,700,000, the British Dyestuffs Corp., Ltd., took over the war-time chemical development and attempted to adapt it to the peace requirements of domestic and foreign trade. The first years' business, 1919-1920, showed a profit of £552,101; 35,500,000 lbs. of dyes were produced and 8,000 hands employed. With the expiration of the year the scarcity period ended and serious competition in dyestuffs recommenced in all the markets of the world. The second year's business, with which the current report deals, despite a "book" profit of £437,684, shows in the reduction of stock values to market prices a net loss of £1,006,660, with a deficit to be carried forward of £803,356.

The situation confronting the corporation arises from (1) the holding of heavy stocks which could not be profitably disposed of at a time when prices were rapidly falling, (2) the import into the country of large quantities of foreign dyestuffs in the twelve months between the delivery of the Sankey Judgment in December, 1919, and the coming into operation of the Dyestuffs Import Regulation Bill in January, 1921, and (3) depression in those textile industries which are the consumers of the corporation's products.

Dr. H. Levinstein, in an address to the commercial committee of the House of Commons in explanation of his resignation because of disagreement in matters of administrative policy, stated: "Up to October, 1920, the range of dyes which I put on the market was a scarcity range. I knew the requirements of the textile trades too well to suppose that in normal times you could restrict the dyers and calico printers to such a range. Early in 1921 the works were practically closed down—competition recommenced. The 1914-1920 range had served its time. That was why the fact was so surprising that not one single addition to the range of dyes made by the corporation was put on the market for seven months after the technical direction of the board was replaced by direct Government control. The works were idle, the chemists were idle, staff was dismissed, and research information, which we had spent £166,000 in 1919 and 1920 alone (excluding capital expenditure) to acquire, was scattered to the ends of the earth. To make many of the colors it would not have been necessary to spend fresh money; the processes were known, the raw materials were in stock."

Dyestuffs Import Regulation Act

Sir William Alexander, chairman of the board, in his discussion of the attitude of English dye-users in the report referred to, is suggestive of the American situation as regards the attitude of some consumers of dyes towards the development of an American domestic dyestuffs industry, protection of which is far from the stage it has reached in England. Sir William says:

"I now pass to the agitation which, as you are well aware, has grown up recently for the repeal of the Dyestuffs Import Regulation Act. The agitation has received support from various interests, and it is, of course, the privilege of any British subject to work for the repeal of an Act of Parliament which he considers obnoxious or detrimental to his trade. I would remind you, however, that this Act was passed with the support of a majority of the color users in this country and in fulfilment of the pledge given by his Majesty's Government to afford security for a term of years to the dyestuff industry. On the strength of this pledge, shareholders were invited to invest their money in the company. Let me again point out that the dye users have a majority to represent their interests upon the Licensing Committee which has been set up under the Act, and this I venture to think should be an adequate safeguard. Nevertheless the policy of this corporation will be to assist the user by every means in its power consistent with the security of the industry.

"Efficiency in every direction is of paramount importance if the dye-making industry is to be established in this country. Much more than this, however, is necessary. There must be recognized on all sides that special facilities are required for this purpose, and that some form of security against the temporary ability of Germany to sell at very low prices must be maintained. If the color users of this country are not prepared to recognize this position and to support us to the utmost of their power, I cannot see how this company, for the formation of which they are largely responsible, can succeed, or that the directors would be justified in advising the shareholders, at the risk of their capital, to continue their efforts for the establishment of a national dye-making industry."

Conditions of English Manufacture

"The present conditions affecting the manufacture of dyestuffs in Great Britain are so different from the conditions in Germany prevailing before the war as to render comparison of this nature subject to many important qualifications.

"Another basis of comparison has been to compare prices at present quoted from Germany with the British price, and here my only comment is, considering the difference between the internal and external value of the mark, that the prices quoted by the German firms to this country are not considerably lower. These sterling prices, when converted into marks, are considerably higher than the home prices in Germany, and may perhaps give color-users an indicaiton of the policy the German firms would adopt if we again surrendered the independence which the war taught us was essential to our national security."

Working Agreement with German Dye-Makers

The endeavor of the *Interessen Gemeinschaft* to regain in some measure the position lost by war has assumed different forms in the different manufacturing nations that have sought to become independent of the German dye *cartel*. The situation in America as regards the attack on the Chemical Foundation, Inc., is believed by many to be the local aspect of what is a general movement by the *cartel* and its agents resident in the countries concerned to recover advantages submerged for the time by the patriotic endeavors of the various nationals, as encouraged and confirmed by legislation. The situation in England is described further by Sir William Alexander:

"The position at the moment is one of great delicacy, and requires more than ever complete confidence in the judgment and ability of your board. Negotiations are in progress both with the Government and with the color users which may have an important bearing on the future of the industry. Informal discussions have taken place between the representatives of the German dyemaking industry and those of the British Dyestuffs Corp., Ltd. The object of these discussions has been to discover, if possible, a plan which will secure a satisfactory working arrangement between the dyemakers in Germany and those in this country. Whilst we would welcome an arrangement with the German undertakings, it must be on such terms as will leave inviolate the principle upon which our undertaking was founded, namely, the establishment of a dyemaking industry in Great Britain adequate to our needs both in peace and in war. So far, however, the German interests are not of the opinion that circumstances are such that they are prepared to accept this fundamental principle which we have laid down as a basis for close cooperation."

Opinion of Dr. Levinstein

As regards the difficulties confronting the British Dyestuffs Corp., Ltd., and the proposed agreement with the *Interessen Gemeinschaft,* Dr. Levinstein, in his address before the Commercial Committee of the House of Commons, said: "To some the solution of all the difficulties appears to be merely the acquisition of the so-called German 'secrets.' It is not the possession by the Germans of these 'secrets'—I will use the cant word—in which their strength is rooted; What is the source of their strength is the technical knowledge that produced these secrets and how to exploit them, and is still going on ever progressing with new secrets. What is the counter move? There is only one. Be as technically strong and be as efficient. There is no short cut." Dr. Levinstein emphasized the uselessness of running a great chemical research department in a business directed by a man without technical knowledge; unless behind the research department there are those with the technical knowledge, imagination and insight to recognize a potentially commercially valuable process in a laboratory preparation, and unless there are technologists to develop the idea and a great sales department to create a market. The examination of results, the carefully balanced judgment in the selection of suitable substances after the examination of their properties, is, he urged, a vital part of research—perhaps the most difficult part, and certainly the one in which the most striking mistakes have occurred in the past history of the industry.

Science vs. Economics

The American Bankers' Association, through its economic policy commission, of which Melvin A. Traylor of Chicago is chairman, has appointed a committee of prominent bankers to acquaint the people with the fallacies and dangers inherent in the doctrines expounded by well-known men whose technical and scientific attainments give their convictions on matters unrelated to their specialties a background of plausibility.

The committee will give particular attention to the very subtle and dangerous schemes proposed by certain influential but ill-advised citizens, for the expansion of the circulating medium of the country, such as are involved in the legislation advocated by Dr. E. F. Ladd, Senator from North Dakota, that the soldiers' bonus be financed by Government obligations which will circulate as currency in the ordinary channels of trade and other proposals for the issuance of purely fiat money, as advised by Henry Ford and Thomas A. Edison in the operation of the Muscle Shoals plants and water power for the ulterior advantage of private citizens.

The committee says that never before in the history of the world has there ever been so striking an example of the inevitable and fatal results of printing press money as is to be found in the Central European countries at the present moment. For the safety of American industry and commerce, it cannot be too often repeated that the collapse financially of the central empires was absolutely inevitable from the day they began financing their entire operations through the issuance of their printed promises to pay. It cannot be too forcefully emphasized that rich and powerful as this country is, disaster would certainly follow in the wake of any wild period of inflation, such as would be created were some of the so-called currency panaceas actually put into practice.

George A. Loomis, formerly of Bureau of Standards, is now with Ohio Valley Clay Co., Steubenville, O.

The Chemical Foundation, Inc.

THE action of the administration at Washington against The Chemical Foundation, Inc., as expressed by President Harding's order of July 1, to the Alien Property Custodian, directing him to demand from The Foundation the return to the Government of all German and other alien enemy patents taken over by The Foundation under the Wilson regime, comes as a climax in the campaign to thwart the patriotic endeavor of American chemists to make the nation independent in the key essentials to its existence. The Executive order states: "It appears that the sale was made at so nearly a nominal sum that there is reason to believe that this Government has not faithfully observed the trust which was implied in the seizure of this property. The circumstances relating to the entire transaction are of such a character that full investigation becomes a public duty."

The circumstances attendant upon the war-time disposition of alien-owned patents are well known and were set forth by Mr. Garvan, president of The Foundation, in his testimony, March 6 (CHEMICAL AGE, March, 1922, p. 97-100) before the Senate Committee engaged in the investigation of the alleged monopoly in domestic dyestuffs manufacture. In the light of the publicity of the facts, of the patriotic purpose of the organizers of The Foundation, and of the legislation under which it was created, it is apparent that an aspect of a transaction whose object was to advantage the American people under conditions that could imply no favor to any private interest, has been seized upon by the present administration, with much relish to the alien interests which would benefit from the demoralization of American chemical enterprise built up under Government sanction.

In explanation of the Government's attitude in a matter of great moment naturally to the interests that have invested millions in the development of a native organic chemical industry and which stands to lose correspondingly in any removal of the support upon which these investments were made, the following statement by the Department of Justice reads:

> Officials of the Department of Justice on July 8 took cognizance of the statement issued by Francis P. Garvan, former Alien Property Custodian and now president of the Chemical Foundation, the return of whose patents, taken over from the Alien Property Custodian, the Government has demanded.
>
> Officials of the department called attention to the fact that the Chemical Foundation last week brought sixty-seven suits against the Treasurer of the United States to collect several hundred thousand dollars of royalties which had been paid to that official on account of the patents now held by the Chemical Foundation while they were in the trusteeship of the Alien Property Custodian.
>
> They pointed out that it was the duty of the administrative officers of the Department of Justice to defend these suits against the Government, and that the decision to do so was reached in view of the fact that there was only one way to act in the best interest of the Government to adjudicate the whole question in the most practical and expeditious manner possible and save to the Government and the litigants a great deal of unnecessary expense.
>
> Officials of the department, it was said, believed that since the Chemical Foundation had indirectly attacked the original conveyance by the Alien Property Custodian, that sound legal principles required that in the defense of these suits the original conveyance as well as every incidental step therein, should be set aside and the matter considered anew.
>
> It was further stated by officials of the department that the amount for which the Chemical Foundation is suing the Government, is a larger sum than the Chemical Foundation paid for the patents, and that the policy adopted by the Government of meeting the situation in one suit was much more to the advantage of the Government in bringing about a settlement of the controversy than would have been the case if the Government had become defendant in the sixty-seven suits brought by the Chemical Foundation.
>
> With respect to Mr. Garvan's alleged explanation of his reason for saying previously that President Harding's action last week in demanding the return of these properties was taken without consideration of or notice to the Chemical Foundation, officials of the department called attention to the fact that the Government had no notice that the Chemical Foundation would bring sixty-seven suits against the Government only one week before the statute of limitations would run out, a circumstance which might have been to the prejudice of the Government.
>
> It was also said by officials of the department that representatives of the German Cartel, comprising the organic chemical industry of Germany, called at the Department of Justice recently relative to thirty-odd suits to be instituted by them against the Government on behalf of their clients, but that they had absolutely nothing to do with any action of the department against the Chemical Foundation.
>
> It was pointed out that the Department of Justice had been investigating the transaction between the Alien Property Custodian and the Chemical Foundation for many months prior to the arrival of the German representatives, as Mr. Garvan and his associates well know, and prior to the action of the Chemical Foundation in precipitating an unexpected situation by bringing sixty-seven suits against the Government, involving a very large sum of money.
>
> It was pointed out that the return of these patents to the Alien Property Custodian would in no sense benefit the former German owners or interests. The action taken by the Government has been wholly in the interest of the Government itself. The disposition of these patents after return to the Alien Property Custodian, as well as all enemy property held by him, must be determined by action of Congress.

It is evident that the American chemical industry has entered upon a protracted period of uncertainty in which will be rehearsed the events of the past few years with a finale which leaves much in doubt as to the ability of American chemists, lawyers and legislators to retain as a national asset a war-created industry.

The friendly actions instituted by the Chemical Foundation, Inc., against various concerns operating alien-owned patents under licenses granted by the Federal Trade Commission, which later were sold to the Foundation by the Alien Property Custodian, were for the purpose of establishing the title of the Foundation to the funds in the custody of the United States Treasurer and paid long since by the defendants for the use of patents now owned by the Foundation.

The Trading with the Enemy Act provided that these funds be held in the United States Treasury as a trust fund for the owner of the patents and for the licensees, as their respective rights might be determined by suits to be brought by the owner against the licensees. This provision compelled the Foundation, which would have no difficulty in agreeing with almost all of the licensees, to bring such suits as the only means of securing from the Treasury moneys to which it is entitled.

The United States Treasurer, as custodian of the funds, necessarily was joined as co-defendant. It is these actions that, according to the statement of the Department of Justice, precipitated the demands, under Executive order, of the Alien Property Custodian upon the Chemical Foundation, Inc., to return the patents sold to it by his predecessor.

Attitude of the Administration

In addition to such action as the Government promises to institute against the Chemical Foundation, Inc., the Alien Property Custodian ordered, on June 29, suits filed in five states to protect the alien owners from the loss of royalties and license fees which would occur otherwise with the expiration of the Trading with the Enemy Act on July 2.

The Alien Property Custodian states that these funds legally and equitably belong to the owners of the patents, trade-marks and copyrights, but under the law would revert to the licensees if suit is not instituted prior to July 2. As the owners of these patents, trade-marks and copyrights have been prevented from instituting these proceedings, the custodian is acting for and in their behalf, and by so doing, these funds, which aggregate many thousands, will be retained by him for the benefit of the owners thereof, or pending disposition by Congress under the law the Alien Property Custodian would have been required to return the money to the people who had paid it to his office under the license, although they had the use and enjoyment of these patents, trade-marks and copyrights.

Mr. Garvan's Protest

In a letter to President Harding under date of July 15, Francis P. Garvan sets forth the legal sanctions surrouunding the organization of The Foundation and the baselessness of the Alien Property Custodian's position as trustee as claimed in his attack on the Foundation. He says:

"The United States Government has no interest in the suits brought by The Chemical Foundation in reference to the Federal Trade Commission's licenses. That dispute is between The Foundation and the former German owners. If they both failed to prove their claim, the money in the United States Treasury must be paid back to the Americans who used the patents and paid in the money. The United States Treasury is only the stakeholder.

"At the time that Woodrow Wilson, President of United States, delegated his power of sale to Frank L. Polk, Acting Secretary of State, who authorized the Alien Property Custodian to sell the patents to The Chemical Foundation, neither the President, the Secretary of State, nor the Alien Property Custodian was under the law in the remotest sense a trustee for the German enemies, nor were they such at the time the patents were taken over by the Custodian.

"This sale was made under Congressional authority and in the full light of all branches of the Government and in the full light of publicity. The idea underlying the formation of The Foundation was the result of the intimate knowledge of the past use of the German patents in a manner hostile to the United States' interests, and in full consultation with all the executives of the Government, the experts of our Army and Navy, and leaders of our chemical business organizations and the heads of all our scientific and research organizations.

"Thus it will be seen that this sale was made by the Chief Executive of the United States acting under proper authority from Congress, and consisted of property absolutely owned by the United States and disposed of by him after months of the most exhaustive consultation with every possible person cognizant of the lessons of the war and competent to advise, so that the final steps in that victory might be insured and accomplished.

"It is the first time in the history of the United States Government that the Chief Executive has been advised by his Attorney General to attempt to abrogate the solemn Executive Order of his predecessor. It is the first time in the history of the United States that the Chief Executive has been advised by his Attorney General to violate a sacred contract entered into by the Government with its citizens.

"You, Mr. President, apparently upon the report of the Attorney General, base your entire decision upon the assertion that the sale was made at so nearly a nominal sum that there is reason to believe that the Government has not faithfully observed the trust which was implied in the seizure of this property.' What better test of the actual value to The Foundation of the property sold to it than the result of its three years' operations? Two hundred and seventy-one thousand eight hundred and fifty dollars was paid by the Government, and $157,050 working capital was provided by 150 American firms, on no dollar of which would any one of them receive more than 6 per cent., but who never have received anything, and whose entire investment you now demand be destroyed. The total or gross income has averaged $143,216.65 per year. The running expenses, exclusive of all educational activities, the bare overhead expenses, have averaged $121,971.35 per year, or a net excess of $21,245.30, which is .049 per cent. on $428,900 actually invested. This allows nothing for depreciation. The average life of the patents is eight years so that twelve and a half per cent. of the $271,850 cash paid for the patents, or $33,981 per year, should be subtracted from the above apparent net receipts for each year, which leaves an actual annual operation deficit of $12,735.70, and The Chemical Foundation has in addition spent $264,017.85, the entire balance of its capital, in educational work. The Attorney General has made no investigation of The Chemical Foundation or the facts surrounding its formation. Listening to German agents, German commissions, or former German lawyers exclusively is not an investigation.

"Mr. President, you have had the temerity to impugn the honor of the gentlemen who boast a part in the great work of building up or preserving the possibility of progress in organic chemistry for America. You have again been misinformed as to the nature of the trust we bore. That trust was not for the German Kartel, the owner of practically all the important patents, who had received them under the unthinking graciousness of laws they had induced. That trust was for the safety of American people and their industrial independence."

The well-known Philadelphia consulting chemical organization established many years ago by Dr. Samuel P. Sadtler of the Philadelphia College of Pharmacy and Science and with which he is still connected in an advisory capacity under the administration of his son, Samuel S. Sadtler, '95 M. I. T., announces the appointment of Dr. Elbert C. Lathrop, formerly of E. I. du Pont de Nemours & Co., as vice-president and treasurer.

Dr. Lathrop after graduation from Depauw University in 1907 was for 9 years with the Bureau of Plant Industry in the Laboratory of Soil Fertility Investigations, where his researches earned him the Longstreth Medal of the Franklin Institute in 1912. In his work with the du Pont organization since 1918 he latterly was manager, Standards Division, Chemical Department, charged with the responsibility of standardizing all testing and control methods and drafting specifications for materials used, as well as studying methods for the utilization of waste and by-products, which experience has been at the disposal of the American Society for Testing Materials, in which he has served on several of the most important committees. Dr. Lathrop in his new connection will devote his entire time to consulting work and the solution of industrial engineering problems.

* * *

E. V. Kyser, chief chemist, Cincinnati Soap Co., and retiring president, Cincinnati section of the American Pharmaceutical Association, has resigned to accept the professorship of manufacturing pharmacy, University of North Carolina, Chapel Hill, N. C.

Adhesives from Starch

To produce adhesives from starch or substances containing starch the latter is decomposed with alkalis, usually caustic soda. The product thus obtained has a great agglutinant power and is used extensively under the name of vegetable glue. To carry this process through and to obtain adhesives fit for practical use it has been necessary to use rather large quantities of alkali. If this is disregarded, the decomposition remains incomplete and the adhesive obtained will after some time be converted into a pasty substance unfit for use.

Influence of Pressure on the Proportion of Hydrolyzing Agent

It has been ascertained that it is possible to reduce the quantity of alkali necessary for decomposing starch very considerably, if the decomposition is effected under pressure. If starch-paste is heated in a closed vessel under pressure, say, to 125-130° C., the starch is temporarily liquefied, but no adhesive is formed, as after the solution obtained has cooled down, the starch which apparently has been dissolved separates out again for the greater part and the entire solution coagulates into a jelly-like mass.

If it is proposed to convert the starch into sugar by aid of diastase, as in the manufacture of spirits, this coagulation is of no avail as the starch is, before coagulation can take place, decomposed further by the diastase. On even very small quantities of acid being added the result will always be a conversion of the starch into sugar.

Dr. Ernst Stern, of Hanover, Germany, has found (U. S. Pat. 1,412,000) that the results will be altogether different if very small quantities of alkali are allowed to act under pressure on the raw material. If the process is modified in this way, colloidal solutions of starch are obtained which are absolutely durable and possess extraordinary agglutinant qualities. Minute quantities of an alkali will produce this favorable effect. While the conversion of starch under ordinary pressure, in order to produce adhesives, necessitates the addition of at least 2 per cent, alkali, with increased pressure such as 5 atmospheres, or at least a pressure greater than 3 atmospheres and less than 15 atmospheres, only ¼ to ½ per cent. alkali, and even less, is required. In fact, instead of caustic soda or potash a great number of salts having an alkaline reaction may be employed. Under ordinary pressure the conversion of starch into adhesives permanently fit for use by aid of carbonate, silicate or phosphate of soda is impossible, whereas, if increased pressure is applied, no difficulty is encountered. Weaker bases such as ammonia, further ammonium salts and organic bases may be employed also.

The starch is first subjected to high pressure in admixture with water but without alkali, whereby the starch is converted into a soluble condition. After this conversion is completed, very small quantities of hydroxyl ions in the form of an alkali or of salts having an alkaline reaction are added to the hot solution. Thus the starch is thus first dissolved and only then does the treatment for obtaining the adhesive commence. This modified process has the advantage that no discolorations occur.

The adhesives obtained in this manner are distinguished by a very high agglutinant power and a high degree of fluidity. Their practically immaterial content of alkali renders them especially valuable as compared with a great number of other vegetable adhesives. The adhesives obtained by this process are intended to be used chiefly as glue for wood. The principal qualities required for glue and which make the glue adapted for use in the cold, are a superior spreading capacity in combination with a high agglutinant power. In general these two qualities are not to be found in combination; if a cold-glue possesses the spreading capacity required for wood, it is generally lacking in agglutinant power, and vice versa. In order to overcome this difficulty the process may be modified as follows:

Addition of Xanthogenates to Improve Spreading Capacity

It has been ascertained that the xanthogenates or xanthic acid compounds of carbohydrates, and more especially of starch and cellulose, endow the cold glues with the superior spreading capacity required, without, however, depriving them of their high agglutinant power. If viewed in the light of colloidal chemistry, the xanthogenates may be said to form the sols which after having been spread upon the surfaces of wood to be glued, will be converted by the action of air into gels having a very high agglutinant power. The xanthogenates of carbohydrates that are decomposed by hydrolysis or oxidation have proved to be especially adapted for this purpose, especially when such are employed mixed with starch. The thiocarbonate and starch form mutually a system of protecting colloids, for while either the thiocarbonate or starch alone readily passes over from the sol condition into the gel condition, this is not the case with the mixture. The change into the gel condition, on the other hand, occurs only when the adhesive has been applied. This circumstance materially influences the durability of the wood-adhesive.

The process may be carried out in the following manner: Starch is subjected to a limited decomposing treatment, and the starch thus partly decomposed is converted partly, into the xanthogenate by allowing carbon disulphide to act upon it. According to the degree of decomposition of the starch and to the percentage of partly decomposed starch converted into xanthogenates (thiocarbonate), the spreading and gluing capacities of the product obtained will be correspondingly pronounced. To the starch-xanthogenate-glue a certain quantity of the corresponding cellulose compound may be added.

The compounds mentioned are distinguished by their extraordinary capacity for jellification, this capacity being characteristic of an adhesive adapted to be used for gluing wood. Of course this capacity of forming jellies should be made use of in such a way as to furnish a fluid glue permanently ready for use.

Details of Procedure

The following are examples of methods of carrying out the process:

Example I.—200 kg. of starch is stirred thoroughly with 200 kg. of water and brought by heating to 60° C. to the swollen condition. The swollen starch is then converted into its alkali compound by the addition, while the swollen starch is continually stirred, of 15 kg. of caustic soda dissolved in 75 kg. of water. Thereupon 7.5 kg. of carbon disulphide, quite cool, is added, with constant stirring. By observing a temperature of not above 25° C., the formation of the thiocarbonate is completed in a few hours; the progress of the reaction can be observed readily, in that the odor of carbon disulphide lessens and finally disappears altogether. The product of the process is a wood-glue of excellent qualities and durability.

The process may be modified by exposing the swollen starch, while in an autoclave provided with a stirring device, for about three hours to steam pressure of 5 atmospheres. By this treatment, the starch gel passes over into a starch sol; conversion into the thiocarbonate results from the treatment with alkali and carbon disulphide as described in the following example:

Example II.—200 kg. starch is mixed with 225 kg. of water into a mash and dissolved by the addition of 15 kg. of soda lye in 75 kg. of water. After solution has been effected, the temperature is lowered to 40° C. and from 1 to 3 kg. of a powerful diastatic malt extract, and in addition thereto 2 kg. of 3 per cent. peroxide of hydrogen, are added thereto. Instead of this procedure, the decomposition may be brought about purely by oxidation, by adding from 2 to 4 kg. of 3 per cent. peroxide of hydrogen. The temperature is gradually increased to 65° and the ingredients are kept at that temperature for one hour. Then they are cooled down to from 20 to 25° and the reduction into thiocarbonate is effected by the addition of from 8 to 10 kg. of disulphide of carbon.

Example III.—2 kg. of cellulosic material is steeped in 6 kg. of 30 per cent. soda lye and the ingredients are left undisturbed for twenty-four hours. The soda lye is then squeezed out to such an extent that the weight of the alkaline-cellulose amounts to approximately 6 kg. 2 kg. of carbon disulphide are then added, and after the lapse of a few hours 6 kg. of water. The viscous solution is purified by precipitation with a solution of common salt and is then steeped in the smallest possible quantity of water, to which latter small quantities of soda lye may be added, if necessary. 20-50 kg. of the purified cellulose solution is added with constant stirring to the alkaline starch prepared as described in Example I, care being taken to insure uniform mixing at a temperature not exceeding 25° C.

Carbon Tetrachloride in Fire Extinguishers

The condemnation by Dr. E. E. Butterfield, New York City chemist in charge of the Queens Borough laboratories, of the Pyrene fire extinguisher for use in confined spaces whereby the fumes evolved are inimical to human life is a result of the investigation of the recent disaster in the Lexington Avenue subway, New York City. Dr. Butterfield explained that the extinguisher is of the carbon tetrachloride type, the decomposition of which releases a small percentage of phosgene gas.

Morton Arendt, consulting engineer in the New York City Department of Plant and Structures characterized as "criminal" the use of Pyrene fire extinguishers in confined spaces such as the subway. Naval officers of submarines had been ordered in 1919, he said, not to use it because of the poisonous fumes of chlorine gas and its compounds given off by it in confined spaces. In a fire in the Boston Navy Yard, he said, these gases had caused the death of two persons.

The mayor of the city also has rushed into print and given his complete clarification based upon the experience gained when acting as a fireman and engineman on the elevated railroad, before they were electrified and before Pyrene was used commercially as a fire extinguisher.

Chemical Age holds no brief for the Pyrene Mfg. Co., but is interested in protecting any chemical industry against unwarranted criticism of its product. The active principle of Pyrene, carbon tetrachloride, is liquid at ordinary temperatures, but assumes the gaseous state when subjected to heat. By virtue of its greater density it settles upon the burning mass, thus displacing air, and so deprives combustion of its support, i. e., oxygen.

In repeated tests conducted by the Underwriters Laboratories, Pyrene has extinguished electrical arcs or short circuits produced by high currents within the space of seconds. In this case it acts as a non-conductor between the two poles of the arc, and is efficacious in this respect until the gas is dissipated, during which period the current can be cut off.

It is quite true that during the instant that the carbon tetrachloride comes into contact with the high temperature arc, in the presence of the oxygen of the air, the tetrachloride is slightly decomposed forming very small amounts of phosgene ($COCl_2$) and chlorine (Cl). Hydrochloric acid (HCl) also may be formed.

It must be understood, however, that the quantity of the compounds mentioned is negligible and hardly would be sufficient to be uncomfortable. Such is not the case, however, with the vulcanized rubber of insulation. Not only are the fumes formed by the burning of raw rubber stifling and unpleasant, but vulcanized rubber is a compound of raw rubber and sulphur. It is our opinion that it was the burning of this insulating material which caused most of the suffering.

The real danger in the subway is not the burning of the insulation, or the small quantity of noxious fumes formed by the decomposition of the carbontetrachloride, no matter how unpleasant that may be, but that the short circuit will start a fire in the flammable seats of the car. Such a fire obviously, could not be stopped, by the cutting-off of the electric current, but quickly could be quenched by the pyrene extinguisher.

To follow the logic of some of the criticism of this device to its conclusion, it apparently would be better to be burned to death in the subway by a fire that readily could be extinguished at its inception than to be subjected to the unpleasant effects of the minute quantities of noxious fumes that are produced when the agency is first applied.

Charges by City officials of "criminality" in retaining in use in the City's subways of a device that is endorsed by the Underwriters' Laboratories and is the standard equipment recommended by the National Board of Fire Underwriters and which is approved by the Bureau of Mines, is inconsequential in comparison with that involved in removing from the subway a device of recognized value for putting out a fire quickly. The crux of the matter lies in electrical control rather than in senseless condemnation of a useful tool. And the final question is: Is there anything better to take its place?

Carnegie Institute of Technology at Pittsburgh has been selected by the United States Naval Academy to give advanced courses in metallurgy to its graduate officers. The institution is the only school in the country chosen for this work, and its selection is a tribute to the high standard of its engineering curricula. F. F. McIntosh, associate professor in metallurgy, will supervise the studies of the naval officers, Lieutenants Gilbert C. Hoover and John H. Keefe, who have been assigned to take the work the next college year. Their studies will be graduate work in advanced metallurgy with some studies in electricity and physical chemistry.

Dr. Gerald L. Wendt resigned on July 1st as associate professor of chemistry at the University of Chicago to join the staff of the Standard Oil Company of Indiana in the direction of research.

Census of Dyes and Coal-Tar Chemicals, 1921

A Preliminary Summary of the Status of the American Synthetic Organic Chemical Industry

In response to the request of Senator P. J. McCumber, Chairman, Senate Committee on finance, of May 4, the U. S. Tariff Commission has issued a preliminary summary of the production of 175 concerns and of the imports and exports of coal-tar dyes and other coal-tar chemicals during 1921, which will be embraced in the Commission's final report which will include for the first time, since it began in 1917 to report the progress of the American dye industry, a census of synthetic organic chemicals other than those derived from coal tar.

Crudes

While the total production of coke in 1921 was less than in 1920, an increased proportion was from the by-product oven, which bears out the historic explanation of the persistence of the wasteful bee-hive oven that it would be displaced just as rapidly as a stable market for the by-products presented itself and as the diminishing supply of natural gas in metallurgical districts removed this more efficient heating agent as a competitor of by-product oven gas. Assuming that the recoveries per ton of coal charged in 1921 were the same as in 1920, i.e., ammonia (sulphate equivalent), 21.4 lbs.; tar, 8.2 gals.; crude light oil, 2.7 gals., and gas, 10.8 M cu. ft., the estimated production of tar, ammonia, gas and crude light oil in 1921 as compared with 1920 is as appears in the following table:

		Production	
Product	Unit	1920	1921
Tar	gals.	360,664,124	233,000,000
Ammonia	lb.	938,925,522	607,000,000
Gas	1000 cu.ft.	476,485,744	308,000,000
Crude Light Oil	gals	109,709,915	71,000,000

The influence of the industrial depression on the production of coal-tar crudes in 1921 is shown in the accompanying table of production and value figures for 1920 and 1921 by firms not engaged primarily in the operation of by-product coke ovens and gas plants.

Name.	1921			1920		
	Quantity	Value	Value per unit.	Quantity.	Value	Value per unit.
Total crudes	....	$17,936,160	....	....	$21,163,937	....
Benzene.....gallons..	2,171,631	463,205	$0.21	875,561	287,586	$0.33
Naphthalene, crude.....pounds.	16,949,464	380,167	.02	26,393,411	791,403	.03
Anthracene,25 per cent pure.do...	1,604,717	83,707	.21	2,829,500	114,661	.04
Solvent naphtha.....gallons..	649,694	111,286	.17	472,000	74,669	.16
Dead or creosote oil.....do....	28,864,156	3,188,867	.11	37,557,245	4,395,290	.12
Anthracene oil.....do....	2,857,391	519,347	.18	3,284,102	593,839	.18
Pitch of tar.....tons..	347,011	6,514,200	18.77	342,401	5,246,554	15.32
Other distillates.....gallons..	6,562,332	1,209,291	.18	8,052,242	1,577,727	.20
Refined tar.....barrels..	1,029,282	5,196,427	5.05	1,386,056	7,582,553	5.47

Intermediates

The total production of intermediates in 1921 by 107 manufacturers fell off 73 per cent in quantity from the output of the preceding year, the number reported being 232 as against 236 in 1920, of which 49 were reported for the first time. Many of them were of especial importance in the progress of the industry as they are required in the production of the more complex and faster types of dyes and represent a significant development in the industry inasmuch as heretofor they had been imported. The notable falling off in output, as appears from the inspection of the table, arises from the loss of most of our export trade in dyes, the large carry-over from the preceding year and the general business depression. There has been a general decline in intermediate output from the war-time peak of 1918 when the requirements of munitions, prison gas and special dyes for military fabrics abnormally enhanced production.

In general the intermediates required for those dyes consumed in largest quantity show large reductions, while there have been increases in certain intermediates of the more specialized types. Withal the tendency during 1921 has been toward the production of intermediates which more nearly represent normal domestic requirements.

Dyes and Other Finished Products

Dye production in 1921 by 74 manufacturers totaled 37,008,690 lbs., a decrease of 56 per cent from the output of 1920. The 1921 sales exceeded production by 22 per cent., indicating that a part of the domestic consumption for that year was supplied from stocks carried over from the previous year's abnormal production. The same influences that reduced the output of intermediates in 1921 likewise affected dye production.

	1920			1921			
	Number of manufacturers	Production.		Number of manufacturers	Production	Sale	
		Quantity.	Value.		Quantity.	Quantity	Value
		Pounds			*Pound*	*Pound*	
Group II—Intermediates	119	257,726,911	$95,291,686	107	70,899,912	$33,677,326	$8,483,463
Group III:							
Finished products	161	112,942,227	112,731,547	147	51,457,765	60,434,009	47,906,514
Dyes	82	88,263,776	95,613,749	74	39,008,690	47,513,762	39,283,956
Color lakes	43	10,983,538	5,871,820	43	6,152,187	6,424,612	2,863,189
Photographic chemicals	8	440,759	1,015,848	5	183,748	170,221	248,041
Medicinals	35	5,184,989	5,726,776	34	1,540,917	1,876,246	2,930,324
Flavors	15	166,884	527,493	17	901,245	933,662	1,002,018
Perfumes	12	99,740	332,008	1	119,335	119,691	175,815
Tanning materials	4	3,142,861	233,674	4	1,902,597	1,721,359	141,005
Synthetic phenolic resins	4	4,659,680	3,410,179	5	1,643,796	1,674,456	1,352,104

The progress of the year includes the manufacture for the first time in this country of a large number of dyes of greater complexity and more specialized application. The development of these products is a highly technical achievement and creditable to the industry. Dyes of each class (according to application) are among the new products manufactured in 1921, and a considerable number of these new colors were among the most important colors not heretofore made in the United States. This progress has continued during the spring of 1922, as production of many new dyes has been reported during the first five months of the latter year.

The production of dyes in 1921, grouped by classes according to method of application, appears in the following table, to which is added the 1921 imports of dyes of the same class and the percentage that each class of imports bears to the total.

Domestic Production and Imports of Dyes in 1921

The total importation of coal-tar dyes during the calendar year 1921 was 3,803,943 pounds valued at $4,654,451, compared with 3,402,582 pounds valued at $5,763,437 during the calendar year 1920. In comparing the poundage of 1921 with that of 1920, allowance should be made for an increase of 303,005 pounds in the 1921 figures, due to the conversion for the first time of the most of the vat dyes to a single strength basis, in order to give the total poundage of any individual vat dye on a definite known basis of strength. The total quantity of dyes as imported in 1921 was 3,500,938 pounds.

Class.	1921			
	United States production.	Per cent of total.	Imports.	Per cent. of total.
	Pounds.		*Pounds.*	
Acid	7,751,698	19.87	1,319,222	34.72
Basic	1,852,243	4.75	154,673	4.07
Direct	6,787,634	17.40	388,715	10.23
Lake and spirit soluble	697,444	1.79	38,090	1.00
Mordant and chrome	3,773,438	9.67	632,285	16.64
Sulphur	10,239,255	26.25	200,653	5.28
Vats (including indigo)	7,019,120	17.99	1,049,712	27.51
(*a*) Indigo	6,673,968	17.11	70,975	1.87
(*b*) Other vats	345,152	.88	978,737	25.64
Unclassified	887,858	2.28	20,594	.55
	39,008,690	100.00	3,803,943	100.00

The imports of 1921 represent 9.7 per cent. of the production during that year, and 8.3 per cent. of the total imports during 1914, when the United States imported 45,950,895 pounds and produced 6,619,729 pounds from German-made intermediates. The dyes imported include those products which are either not yet manufactured in this country or are not yet produced in an adequate quantity or in a satisfactory quality to meet all special requirements.

Germany supplied 47.5 per cent. of the total dyes imported during 1921, a decrease of 3.5 per cent. from that of 1920; 40.3 per cent. came from Switzerland, an increase of 6.3 per cent. over the previous year; 8.2 per cent. originated in England, an increase of 2.2 per cent., compared with 1920; while Italy supplied 3 per cent. of the dyes imported, these imports largely representing re-exported reparation dyes of German manufacture. Holland supplied 0.5 per cent., probably nearly all of German origin, France, 0.3 per cent. The imports of dyes from all other countries totaled 0.3 per cent.

Exports of Foreign Dyes

In 1922 a new classification has been adopted which supersedes the former Commerce Department classification of (1) "aniline dyes," (2) "logwood extract" and (3) "all other dyes and dyestuffs." In the new classification coal-tar dyes are grouped under coal-tar finished products and are divided into (1) "color lakes" and (2) "other colors, dyes and stains."

The combined value of exports of "aniline dyes" and "all other dyes" for 1921 was $6,270,139 compared with $29,823,591 for 1920, and $15,728,499 for 1919. In other words, exports of domestic dyes for 1921 showed a decrease of 79 per cent. as compared with the exports for the previous year. The total exports during 1917, one of the early years when the domestic industry was first expanding from its small pre-war size, were valued at $7,548,963, which is greater than the 1921 exports.

The combined value of total exports of coal-tar "color lakes" and "other colors, dyes, and stains" for the first three months in 1922 was $973,316 compared with $2,432,764 for "aniline dyes" and "all other dyes and dyestuffs" for the first three months of the previous year. In quantity the exports during the first three months of 1922 totaled 1,387,594 pounds. This great reduction in our export trade may be attributed in part to the general business depression; the chief cause, however, was the appearance of German dyes in the principal foreign markets, such as China, India, and Japan, with which the domestic producers have been unable to compete.

As far back as 1919 the Tariff Commission pointed out in its Census of Dyes and Coal-Tar Chemicals for that year that any deductions as to the competitive strength of the domestic industry based on the large exports of 1919 and 1920 were not warranted, as the domestic producers during that period met little competition in foreign markets in German colors. Subsequent developments have borne out the accuracy of the statement, as indicated by the rapid decline in exports during 1921 and 1922.

In view of the search of new uses for chlorine, which is produced in equivalent amounts with caustic soda in the electrolytic decomposition of common salt, the researches of Dr. G. C. Lake, Passed Assistant Surgeon, U. S. Public Health Service, in confirming the efficacy of carbon tetrachloride as an anthelmintic for hookworm in dogs and monkeys and the opinion that its use in the treatment of hookworm in man is worthy of an extensive trial,* should not be without interest to the manufacturers of this compound. The wide prevalence of this disease in sub-tropical and tropical regions, with its retardation of their economic development, and the fact that Dr. Lake states that a safe dosage may be as much as 10 c.c., make the use of carbon tetrachloride for this purpose worthy of encouragement. Dr. Lake adds by way of caution that care must be taken to see that the capsules are swallowed promptly. Should one open in the mouth or throat and some of the drug enter the trachea, serious results might follow.

W. A. Durgin, chief, Division of Simplified Practice, Department of Commerce, has been appointed a member of the American Engineering Standards Committee created by various technical societies to investigate methods calculated to bring about simplification in sizes and varieties of commodities. Liaison between the Committee and the Department of Commerce further is provided by the appointment of A. A. Stevenson, former chairman of the Committee, as a member of an advisory committee to the Division of Simplified Practice.

American industrialists are requested to supply to the Committee suggestions as to what things may be done in the interest of waste elimination through the introduction of standardization in sizes and varieties of commodities. Mr. Durgin would like to have anyone who is in a position to do so to give thought to the manufactured articles he is in touch with and to consider the possibilities of standardization. Thus he may help in the efforts to reduce waste in industry.

---

*Public Health Reports, May [illegible], 1922.

Standardization and Cheaper Goods

The Role of Standardization in Production and Its Influence on Industrial Progress

By Charles le Maistre

Secretary, British Engineering Standards Association

STANDARDIZATION is not an easy term to define. There is nothing, however, new in the idea, for it has been practiced in one form or another for many centuries. It started from the moral and social side with standards of conduct, standards in art and in literature and so forth, and in later years has developed gradually as an economic movement in the production of the material necessities of life, a departure of interest to everyone, seeing that it implies both the study and the preparation, as well as the recognition of standard forms and qualities.*

Standardization Defined

In its broadest aspect standardization may be said to imply the introduction, through collective effort, of economical methods of manufacture, not so much with the idea of gaining dividends as of unifying the needs of industry and thus bringing about the greatest amount of good for the greatest number. But it is not so much a definition of standardization that is wanted as an understanding of its underlying principles, and perhaps the best way of arriving at this is through actual experience in the working out in practice of the standards.

It is still sometimes urged against standardization that it retards invention and progress, and that once a standard has been adopted there is no possibility of modification or change even though new methods may have demonstrated their superiority over the old. Happily this is not the case so far as industrial standardization is concerned when carried on along right lines. Of course, crystallization which would tend to impede or hamper progress must be jealously guarded against so that the work may be of permanent value and the purchaser reap the benefit of competitive effort and inventive genius. Periodic review prevents a crystallization and keeps the work abreast of progress. Nor is standardization coercion either by Government or by one section of the community over the other; indeed, there is nothing compulsory in it at all, its only authority being industrial public opinion.

Industrial standardization does not necessarily involve the idea of actual perfection; it is rather the registering of what is best in present practice as against attempting to set up an ideal. It is quite easy to set up a standard, but it is altogether another thing to get that standard widely adopted, and a standard which is not in accordance with the fundamental needs of industry, that is, which does not fulfill a recognized want, is economically a bad one. It is a wasted effort and a pitfall for the unwary.

Standardization Benefits Both Buyer and Seller

In carrying out the work of industrial standardization, the aim should be to unify the requirements of industry to the best possible advantage without striving for an ideal which might involve an unnecessary sacrifice of capital. It is the buyer in the first instance to whom standardization is of the utmost value, for it enables him to know exactly what he can purchase and to be sure that he gets what he asks for in return for his money.

But it is of equal value to the manufacturer for it simplifies his work, it enables him to produce what is required by the purchaser cheaply and expeditiously, as well as to avoid mistakes. It will thus be seen that the community of interest of the buyer and seller is one of the fundamental ideas underlying the work, for there cannot be the least doubt that the interests of both are really identical.

Elements of Standardization

Every problem of standardization may be divided into the technical and the human side, and in most cases the human side is well over 85 per cent. of the total. The technical factors are usually so well known that the problem so far as this is concerned becomes one of the basic facts rather than of opinion; but when we come to deal with the human side so very little is known of the reasons actuating us all that we deal largely with so-called human opinion, which sometimes is not too closely related to the facts.

It must be remembered that standardization is really a science all its own, and it is only gradually that its underlying principles have unfolded themselves and its great economic utility becomes recognized. Gradually, however, it has come to be seen and appreciated that standardization to be of lasting benefit must first of all be approached through the industrial side, the initial proposals coming from the manufacturers, the constructive criticism being supplied by the scientific and technical experts. That does not say that there are not isolated cases where the reverse is true, and rightly so.

The full realization of the economical side will always result in producing standard specifications which, though perhaps not ideal, yet represent the best which can be devised at the moment, improvements being effected through the process of time.

To be received with confidence by industry, standards must have a certain measure of permanency, and while crystallization must be avoided by periodical review as already mentioned, they must not be changed too often unless the changes are distinctly in the direction of improvements, and safeguards must be created so as to protect those standards from change merely

---

No nation surpasses the United States in the degree to which standardization has been applied in manufacture, of which principle all about us are examples in quality and cheapness of product. Volume production is impossible without it. Notwithstanding our preeminence in this direction much remains to be accomplished in many lines. Chemicals and chemical products are highly standardized commodities, yet there exist in the implements of production such variety of tools designed to accomplish the same purpose as to warrant the characterization of the chemical industry as the least conventionalized of all industries. This is the pecularity of youth, of the formative period of growth, and of an evironment wherein secrecy and the human factor have hampered as much as they may have contributed to the development of generally approved types of mechanical equipment. Obsolescence fades as standardization becomes more distinct; with the high rate of depreciation in chemical equipment standardization would contribute much to lessen the burden of overhead. The Division of Simplified Practice, Department of Commerce, in its promotion of industrial standardization, encouraged and participated in the work of organization of the Chemical Equipment Association whose objects ostensibly are in common with those of Government which seeks the progressive elimination of the waste of industry that its burden on the people may be lightened. The enterprise of the Chemical Equipment Association in this direction will be watched with much interest.—Editor, CHEMICAL AGE.

---

*An address before the General Meeting of the Northeast Coast Institution of Engineers and Shipbuilders at Newcastle upon-Tyne. March 30, 1922.

for the sake of change. Standardization, based on these principles, can never result in fossilization or stultification of invention and progress. Indeed, they invite improvement and progress.

Objects of Standardization

Industrial standardization, then, has for its main objects the elimination of waste of time and material involved in the production of a multiplicity of sizes and qualities for one and the same purpose; the fixing of the dimensions of component parts where interchangeability is necessary; the setting-up of standards of performance whereby comparisons can be made with equity as well as the defining of attainable quality of material which involves unification of tests.

Rapid and economical production certainly may be claimed as one of the leading benefits, and the securing of this is not only advantageous to the manufacturer but also to the consumer in the rapidity with which his orders can be filled from stock, the ready replacement of damaged and worn parts, and not infrequently the reduction in selling price. Notable examples of increased business resulting from standardization can be seen in the well-known cases of the sewing machine, bicycle, motor car, etc. Interchangeability of component parts secured through standardization will give the purchaser the great advantage of an open market.

It should not be forgotten that the setting up of standards or the drafting of national purchasing specifications does not prevent a purchaser from obtaining anything which is not included in those specifications. He may possibly have to pay more for it and perhaps it is sometimes wise that he should. To be of the greatest benefit industrial standardization must be arrived at through the elimination of the unnecessary and the recognition that the recommendations are not unalterable, but rather subject to review, certainly not too frequently as I have already said, but whenever industry finds it economically desirable or necessary to do so.

The aim of those engaged in standardization must be to unify the needs and requirements of industry and that without hampering invention and design, and so encourage and direct progress along the best and most efficient lines.

Standardization, or unification as it might more appropriately be called, as signifying this great community of interest, goes so deep down and touches so closely on life's fundamentals, that to carry it out successfully requires much patience, caution, and evidences of vision, combined with optimism, good will and idealism. Fortunately these qualities are to be found increasingly among those who go to make up the great engineering industry of our country. All who are engaged in serving the public have a unity of purpose which is increasingly recognized, and as time moves on people are more and more willing to sink their individual differences with a view of benefiting the many.

When one considers the public spirited manner in which so many freely give their valuable time and experience to this work, often at so much personal expense and inconvenience, one realizes indeed what a debt the nation owes to our technologists and business men for the part they are taking in this national work.

F. A. Kaufman, manager, California Master Products Corp., Los Angeles, Calif., producers of white bentonite, calcined magnesite, etc., announces the enlargement of its plant to provide warehouse and production facilities.

Fiat Butter

Class Legislation and the Butter Standard

The following brief summary of federal standards defining the composition of butter is eloquent of the pernicious tendency in legislation to penalize the whole people that a few, a group or a class may be benefited. On August 2, 1886, Congress defined butter as follows:

"That for the purpose of this act the word 'butter' shall be understood to mean the food product usually known as butter, and which is made exclusively from milk or cream, or both, with or without common salt, and with or without additional coloring matter."

On February 17, 1898 (30 Stat.—246), Congress passed a law effective in the District of Columbia establishing a standard of butter of 83 per cent fat and 12 per cent water.

On June 6, 1906, under act of Congress approved March 3, 1903, the Secretary of Agriculture defined butter as follows, at the same time stating that butter could be colored by act of Congress:

"Butter is the clean, non-rancid product made by gathering in any manner the fat of fresh or ripened milk or cream into a mass, which also contains a small portion of the other milk constituents, with or without salt, and contains not less than 82.5 per cent. of milk fat."

On May 14, 1919, the Secretary of Agriculture reaffirmed and reannounced the butter standard of 1906.

On Friday afternoon, June 16, 1922 a bill (H. R. 12053) was introduced in Congress, defining butter as follows:

"That 'butter' shall be understood to mean the food product usually known as butter, and which is made exclusively from milk or cream, or both, with or without common salt, and with or without additional coloring matter, and containing not less than 80 per cent. of milk fat and not more than 16 per cent. of water.

A hearing on the bill was announced and held June 17 by the Committee on Agriculture. The Chairman of the Committee developed the fact that the Secretary of the American Association of Creamery Butter Manufacturers had conferred with the Secretary of Agriculture who in turn had conferred with the Acting Chief of the Bureau of Chemistry on this subject and that the three were in favor of the bill. The bill was reported out of the Committee, June 21, striking out the reference to 16 per cent. water, with the recommendation that it pass.

If the present butter bill becomes a law, standard butter will contain 2½ per cent. less food value than is now required of it. That will be the equivalent of adding nominally about 45,000,000 pounds of butter to our present annual production of 1,700,000,000 pounds without increasing the actual food value a single pound. The 45,000,000 pounds of water will increase the revenue of the common carriers and of the manufacturers of butter-containers, and will be bought by the American people at the prevailing price of butter.

To those unversed in the intricacies of public finance we submit this example of "fiat" butter as an analogue of the currency depreciation recommended by well-intentioned but misguided men who are obtuse to the relation that must exist between the production of instruments of credit and the creation of wealth, if the people are to prosper.

Installation of the Cottrell system of electrical precipitation for the abstraction of recoverable values from fumes in the U. S. Assay Office in New York, is expected to effect an annual saving of $7,500-9,000. Contract was signed July 14 by the Research Corp. and the Government for the installation of equipment to cost $35,000, much of which already has been assembled.

Solvent Extraction in the Production of Oils and Fats

By R. A. Bellwood, M. I. Mech.E.,
Rose, Downs & Thompson, Ltd.

IN CHEMICAL AGE for February, 1922, appears an article under the above title, the author of which, Ludwig A. Thiele, Ph. D., claims that the process of extracting oils by means of volatile solvents is due to William Adamson, Philadelphia, in 1879, who was followed by Freidrich Seltsam of Forscheim, in 1880.

Such statements should not be allowed to go forth to the world without verification. Solvent extraction plants were in use many years before the above mentioned dates. Several German technical works state that Jesse Fischer of Birmingham was the first to use a practical extraction plant, this being in the year 1843. Seeing that Fischer did not take out patents for his process, there seems to be some difficulty in proving these statements. It is quite easy, however, to prove that there was a practical solvent process patented in the year 1856. On February 14th of that year, Edouard Deiss took out a comprehensive patent in England, No. 390, for extracting oils, fats, greases and resins from bones, raw wool, seeds and other substances containing the same, by means of "sulphuret of carbon, chloroform, essences, benzene or benzole." This patent application also covered the recovery of the solvents employed by means of distillation, and for the apparatus used for both extraction and distillation.

Deiss also mentioned the use of a current of hot air for recovery from the substances treated, and of refrigerators for condensation purposes. Numerous patents, at least forty, were taken out in England between the date of Deiss' patent, and that of William Adamson. Among these might be mentioned Brooman, 1857, for extracting oil from wool; Hughes 1861; Heyl 1862 and 1867; Richardson, Lundy and Irvine, 1863 and 1864; Hirzil 1863; Richardson 1867; Lake 1869; Mills 1871 and 1872; Freestone and Humphries 1873; Newton and Braun 1874; Sykes 1875; May 1878; and Sanders 1879. The apparatus of F. Seltsam of Forscheim, referred to by Dr. Thiele, was Patent No. 3125, 1880, and was for extracting the fat from bones with the vapours of carbon sulphide, benzene, ether, canadol, etc., under a pressure of 10-12 atmospheres. Such an apparatus was not practical on account of all parts having to be made strong enough to resist the high pressure and to the fact that the solvent losses would be high, due also to the high internal pressure.

As regards the solvents mentioned by Dr. Thiele, he claims that trichlorethylene offers the most important advantages, and states that gasoline (benzine) losses are 0.7 per cent. based on the weight of the raw material and that they are still less for trichlorethylene. While admitting that this may be so, we must not lose sight of the fact that the specific gravity of benzene is only half that of trichlorethylene and that the cost of a gallon of trichlorethylene is about four times that of benzene. As long as there is this difference in price, the writer cannot conceive that trichlorethylene can become a universal commercial proposition. It is an advantage to use "Tri" where there is special danger from fire, and the writer has in such a case recommended its use.

The benzene now used is specially prepared for extraction purposes, and has a boiling point of 90-100° F. and costs only about 2 shillings per gallon. This spirit possesses the advantage that there is no change in the chemical composition during the process, the quantity of oil extracted is great, the oil produced from edible material is of good edible quality, and any escaping vapors have no effect on the health of the operator. What more can be desired; the only disadvantage there can possibly be is of inflammability. The risk, however, is very small indeed, as benzene has a very narrow explosive range, and if ordinary precautions are taken the risk is practically nil. If air contains less than 2.6 per cent. or more than 4.8 per cent. of benzene vapour, it is a non-explosive mixture.

Comment of L. A. Thiele, Ph.D., Am.I.Ch.E.

MR. BELLWOOD in his criticism of my article probably is correct in that Deiss should have been mentioned as the originator of commercial solvent extraction, but as it was not my intention to give an historic review in an article of this kind, I merely stated when commercial solvent extraction commenced to be a commercial success. I am fully aware of the splendid work done by Deiss,[1] who not only perfected the manufacture of carbon bisulphide, but suggested its use in the extraction of oils from press-cake and other material. That solvent extraction by carbon-bisulphide could not attain full commercial success until the methods of purification were thoroughly established is beyond any doubt. The more so, as the crude as well as partially purified carbon-disulphide (as far as it was accomplished in Deiss' time) had a very strong corrosive action upon metals, contained considerable quantities of sulphur, while the extracted oil as well as the residue contained sulphuretted hydrogen and other organic sulphides, which made the oil as well as the residue unsalable. Perfect purification was attained at a much later date than 1868.[2] In his commercial scale extraction Deiss used a cemented brick reservoir, lined with lead, wherein he macerated press-cake. This apparatus, of course, bears no resemblance in any way to our modern plants. Right here I wish to quote from one of my former papers:[3]

> "The extraction of fat and grease by means of volatile solvents already suggested by Deiss, finds another advocate in Tuttle and Lugo. To avoid the loss of glue-yielding substance, which is unavoidable in steaming bones for the purpose of removing grease, even if the steaming operation is continued only for a short time, and furthermore, in order to better the quality of the glue, Deiss experimented until 1868 with carbon-disulphide; but as the glue produced was bad and the fat obtained had such a disagreeable odor as to render it almost worthless, his experiments were discontinued. Vohl suggested in 1871 Canadol (gasoline) as a solvent, whereupon in the same year M. Terne patented the use of petroleum benzine in the United States. But it remained for William Adamson of Philadelphia and Friedrich Seltsam of Forscheim, Germany to solve this problem. Adamson and Seltsam, both

---

[1] E. Deiss, *Braunschweig*, E. P., 390.

[illegible]

prominent glue makers in their respective countries, experimented along the same lines at about the same time (1878). Based upon their experience, Wm. Adamson obtained his U. S. Patent in 1879, while Seltsam's process was in successful operation in 1880. . . The Adamson and Seltsum patents therefore constitute the basis upon which all our modern extraction apparatus is founded.'

It is true there were many attempts made to establish a successful extraction process and apparatus after Deiss made his first experiments in 1856, but as all these experiments by others were based upon carbon-bisulphide, it stands to reason that none has been more successful, otherwise we should be able to find reference in the contemporaneous literature. It furthermore is true that in 1863, Richardson, Lundy and Irvine secured English Patent 2315 for obtaining oil from crushed seeds, or from refuse cake by the solvent action of volatile hydrocarbons from petroleum oils, asphaltum oil, coal oil or shale oil according to a statement of Lewkowitsch, but outside of this reference no authoritative statement may be found in the literature, that this patent was in successful working order and to what extent any of the claimed solvents were used in commercial scale operations. This patent seems to imply the use of petroleum hydrocarbons, without naming canadol, gasoline, petroleum-benzin or the like which were first claimed by Terne (1871).

It is only reasonable to assume that our successful extraction plants were developed from laboratory apparatus, principles and ideas, which in chronological sequence would be, those of:

Payen, *Ann. Chim. Phys.* 1845, 13, 59.
Mohr, *Lehrb. Pharm. & Techn.* 1847, 108.
Schloessing, *Ann. Chim. Phys.* 1847, 19, 239.
Kopp, *Compt. rend.* 1849, 5, 305.
von Bibra, *Gorup-Besanez Lehrb.* 1850, 353.
Robiquet, *J. Pharm. Chim.* 1851, 20, 168.
Schwaerzler, *J. Pharm. Chim.* 1853, 24, 134.
Arnaudon, *Il Union Cim.* 1858, 8, 260.
Schiel, *Ann.* 1858, 105, 257.
Berjot, *Bull. Soc. d'Encouragmt.* 1862, 61, 396.
Fleury, *J. Pharm. Chim.* 1862, 41, 282.
Hoffman, *Zschft. anal. Chem.* 1867, 6, 370.
Storch, *Zschft. anal. Chem.* 1868, 7, 68.
Zulkowski, *Ztsch. anal. Chem.* 1873, 12, 203.
Gerber, *Ber.* 1876, 9, 656.
Drechsel, *J. pr. Chem.* 1877, 123, 350.
Schulze, *Ztsch. anal. Chem.* 1878, 17, 171.
Tollens, *Ztsch. anal. Chem.* 1878, 17 320.
Scheibler, D. R. P. 3573; 1878, D. R. P. 7453, 1879; D. R. P. 9481, 1879.
Barbier, *J. Pharm. Chim.* 1878, 27, 200.
Mally, *Ber. Vers. Stat. Wien.* 1878, 1.
Guérin, *J. Pharm. Chim.* 1879, 30, 511.
Soxhlet, *Dingler.* 1879, 232, 461.
Vohl, *Dingler.* 1880, 236.
Weigelt, *Rep. anal. Chem.* 1881, 1, 7.
Wynter-Blyth, *Chem. Soc. Trans.* 1880, 37, 140.
Thorn, D. R. P. 14523, 1880; D. R. P. 18850, 1881.
Flueckiger, *Ztsch. anal. Chem.* 1882, 21, 467.
[illegible], *Ztsch. anal. Chem.* 1883, 20; West-Knight, Analyst 1883; Denton & Short, *Pharm. J.* 1883, 13, 663.

Johnstone (*Analyst*, 1885, 10, 81), Weyl (*Ztsch. Instrumentenkde.* 1885, 5, 126) and Wollny (*Ztsch. anal. Chem.* 1885, 24, 48) covered the years from 1847 to 1885. The name of Jesse Fisher does not appear in this list, or can any reference be found in patent or contemporaneous literature that Fisher had an extraction plant in operation or made experiments relative to extracting oil from seeds by solvents. So it seems that the validity of Fisher's claim to priority cannot be proven nor sustained, unless one were to accept the statement (Thorpe, *Dict. App. Chem.*, 1916, I, 677) that Fisher used an iron retort in making carbon-disulphide (following its introduction by Deiss) as corroborative evidence to the claim of priority

Taking in consideration that the first claim for the use of petroleum-benzin was filed in 1871 and previous to that time nearly all extraction experiments were conducted with carbon-disulphide, which yielded very odoriferous oils and residue, it seems to be evident that successful extraction was possible only a little after 1871. True there were apparatus of Heyl (Muspratl; *Medicus, Chem. Techn.* 1897, 624) and others using CS_2, but typical representative apparatus appear only after the Adamson and Seltsam Patents, viz.:

Adamson, U. S. P. 216,816, 1979; Brannt, Glue, 1905, 80; Thiele, Trans. A. I. Ch. E., 1921.
Seltsam, *J. Soc. Chem. Ind.* I., 112; Thiele, Leim & Gel. 1907, 34; Rideal, Glue, 1900, 62; D. R. P. Brannt, Glue, 1905, 89.

Then follow with numerous others in quick succession:

Haenisch & Reinhard, 1882, *J. S. Ch. Ind.* I, 391; D. R. P. 18922. 81.
Roth, *Musprat;* D. R. P.; Thorpe, *Dict. app. Ch.*, 1916, II, 483.
Leuner, D. R. P., 17181, 1881; Thorpe, ii, 484; Rideal, 1900, 63.
Merz, D. R. P., 20742, 1882; Thorpe, II, 485; Thiele, Glue, 1921.
Hirzel, D. R. P., 1882. Lake, *J. S. Ch. Ind.*, 1883.

The period around 1878 appears to mark the dividing line or the turning point between failure and success, as all processes and apparatus after Adamson seem to have been successful and those before, not. Without any other authentic data the statement that our modern extraction process and apparatus are based upon the Adamson and Seltsam and Seltsam-Richter patents appears to be fully justified.

Mr. Bellwood also takes exception to my statement as to the advantages of trichlorethylene in extraction, being more costly than gasoline. Conditions on the continent of Europe are entirely different from those prevailing in America. In Europe extraction by gasoline is very common and consequently highly perfected and enjoys, while under strict government rules and supervision in several countries, a comparatively low rate of insurance. Unfortunately American insurance companies do not consider the risk attached to an extraction plant using gasoline as small, or nil, as some of us, and with certain justification, do. They impose a fairly high rate not only for the extraction plant proper, but also for the surrounding buildings, for which plausible reason it would seem to be better to have a safe installation than none at all. With no risk or danger of fire, even if a little more costly than gasoline, the process of extraction by means of trichlorethylene offers distinct advantages. Bellwood's implication that the cost of extraction being four times as high as that with gasoline costing 8 cents per lb. must be considered exaggerated.

Julius J. Dolgos, chemical engineer, Katonah N. Y., while serving in the mounted forces in the Belgian Congo during the war, fell, as he relates, into a deep ravine through which ran a stream from whose bottom he picked up nuggets of gold which he sold to a jeweler for $1,600. He enlisted the interest of several prominent citizens of his community who organized a company, to engage in an expedition to exploit his discovery. The party sailed from New York on June 17, after having taken out life insurance, only to find on their arrival at Brussels to procure official concessions that the life insurance was cancelled and the concession denied. The party thereupon returned to New York.

American Association of Engineers

Extracts from Address at the Eighth Annual Delegate Convention, Salt Lake City, June 5, 1922

By Harry O. Garman, President

As your chief executive officer it is a pleasure for me to open the eighth annual delegate convention of the American Association of Engineers, and give you a resume of the activities of the past year, and for the year before us, to recommend for your consideration, plans and policies to be ordered by you, and carried forward by your national board of executive officers, the chapters, and the assemblies.

It is well for us to remember that the delegates of this convention do not represent a true cross-section of the membership of the Association, but do reflect more particularly the viewpoints of the officers of the chapters and the friends of the officers of the chapters.

The reason for this is that those showing more activity in association matters rise to official positions in the Chapters, and for the same reason are elected as delegates to the National Convention.

In that sense we are the trusted representatives of the rank and file of the membership and we should constantly keep in mind the desires and the needs of our fellow members who cannot be with us on this occasion.

In the past I fear that we have overemphasized in some cases the compensation feature, which may be responsible for some notions which some of our inactive members may have concerning the salary and compensation situation. Progress can only be made along natural channels, and in so far as we are able to see these natural lines of succession, will our efforts be crowned with success.

The world has never rewarded those who are continually asking "What is there in it for me?" "How much do I get out of it?" But the world has always cast its gold at the feet of those who serve.

The reward sometimes takes the form of money, sometimes high esteem and honor, sometimes high position and power.

Compensation will never cease to be an interesting subject, and our Association should always give that subject consideration and should always seek to broaden and make more efficient our employment department. Compensation can be raised to higher levels by making use of the natural laws of social and industrial economics and not by artificial and unnatural means of force.

Seek money and you shall lose it, seek to serve and you shall have wealth added to that which you have. The natural thing to do is to work—to recognize that prosperity and happiness can be obtained only through honest effort. Human ills flow largely from attempting to escape from this natural course.

During the past year the American Association of Engineers tried as an experiment the swing, from a strong, centralized, autocratic government at national headquarters, to a democracy of local chapter control, with an accompanying allocation of funds from national headquarters to the local chapters. The experiment has been all but disastrous, but I believe well worth the cost, because we have profited by the experience of the ill results of both extremes, and now all are willing to settle down on a medium ground, and do those things locally which can best be done that way, and do nationally from the headquarters office those things which can best be done from there.

It is well at this time to take stock of ourselves, measure some of our accomplishments and then plan for another year of greater service and attainment.

There has been an awakening of the group consciousness and a growing realization of the duty to serve society, and to give to our community.

The chapters, more than ever before, have fostered and promoted various civic and public service enterprises, flood control, drainage projects, state highways, municipal streets, bridges, public service extensions, city street traffic ordinances, sewers, prevention of stream pollution, etc., all of which add to the community values, provide legitimate employment, and promote the stabilization of business.

Compensation of engineers has been maintained on a higher level, and continuity of employment has been added, not by artificial methods of force, but by informing the membership where engineering work was to be had, and by seeing that engineers are employed in engineering positions, and by developing and promoting publicity for public improvements, the direct result of which will be an addition to community values, and the ultimate result will be employment, reasonable compensation, and better business conditions.

The Association has aided in defending the word "engineer" against misuse by those who should have used the word "mechanic" or "plumber."

The Association maintains an employment service which has done an immense work, and which every one admits is positively necessary, but which we have not yet gotten down to the best working basis. Here is a problem for the next administration, and will probably be a problem for succeeding administrations.

Much has been done to establish an ethical code, and ethical standards of conduct. This is too little appreciated by the great body of the membership. We must not let our efforts languish along these lines.

We now have 192 chapters and 61 clubs and a membership of approximately 22,000. The United States was districted so that we now have more intelligent voting, the candidate in many cases now being personally acquainted with the electorate. This is a step toward the short ballot, and we get a better choice of officer.

The United States census gives a summary of the number of professional technical men as follows:

	1910	1920	% inc.
Architects	16,613	18,185	10
Designers	11,788	15,410	30
Draftsmen	33,314	52,865	58
Inventors	2,347	2,376	1
Civil Engineers and Surveyors	52,033	64,660	24
Electrical	15,278	27,077	77
Mining	6,930	6,695	4
Mechanical (inclu. all others)	14,514	37,689	160
Chemists, Assayers, Metallurgists	16,273	32,941	100
	152,817	124,957	47
Population of the United States	91,972,266	105,710,620	15

In the decade from 1910 to 1920 the population of the United States has increased from 91,972,266 to 105,710,620, or 15 per cent, while during the same period the number of technically trained people has increased 47 per cent, or about three times the increase in population. When we consider that the country is becoming more subdued, and that state and private institutions are turning out technical graduates in increasing numbers, something must happen.

Someone might make the observation that the production of technical professional men must be curtailed, or the consumption of engineering talent must be stimulated. I believe it is safe to venture the prediction that we need not be alarmed if the production of technical talent does not exceed the increase in population, because as the population becomes more dense the difficulties of existence increase as the ordinates to a curve and not a straight line. It may therefore be safe to assume that the disproportionate increase in engineering and other technical talent will be absorbed by the necessities of a more complex and denser population.

Technical men are met with daily who think the country has gone wrong, when in fact they have been standing still, and the world has moved on.

It is one of the functions of the American Association of Engineers to rescue these misplaced men and to direct their energies into the most productive channels of progress, success and happiness.

Finally, the individual technical man should appreciate that as an individual he is helpless and that he has an opportunity for expression only through some organization dedicated to the promotion of his material welfare. Our American Association of Engineers is this instrument, or device or machine, which he may make use of, at any time.

The Chemist and Boll-Weevil Control

By Lehman Johnson, Ph.B.
Official Chemist of the Memphis Merchants' Exchange

THE boll weevil problem may easily become the most important agricultural problem of our times. Briefly stated, it is:

How may we produce in the United States, in spite of the weevil and our deteriorating cotton lands, our share of the world's need of cotton and cotton seed, whether that need be in the years to come, 10,000,000 or 20,000,000 bales.

For brevity's sake and to avoid misunderstanding, let us call this need a normal production without reference to exact size.

With chemical and scientific control of the weevil and of cotton production, 10,000,000 of present cotton acres could be spared and normal production had at far less total cost of production. Crops of more uniform size would be had; extraordinary stimulus would be given to diversification and a sounder agriculture including the much needed livestock production. But, as already stated, heroic measures would be needed and for some years to come close co-operation between national and State governments and cotton growers, with possibly a special organization with a considerable revolving fund and no little authority.

More particularly, scientific control and production will depend chiefly upon the two fighting chemical elements, nitrogen and arsenic, in enormous quantity and in their proper chemical and physical combination, condition and use.

We must have nitrogen and yet more nitrogen to enable us to concentrate the cultivation of the cotton plant upon some 10,000,000 fewer acres and so raise the production per acre to get the normal needed crop. The use of the acreage saved for other crops or pasture, the reduction in labor costs, the ability to draw nitrogen from the air by means of leguminous crops upon these acres when they are exempted from continuous soil-destroying cotton cultivation, will more than pay the cotton States and their farmers as a whole for all the cost of applying economically and effectively all the older approved indirect methods and the newer direct or poisoning method for the control of the weevil. This could not be done upon an extended acreage or upon a low yield per acre.

We must have arsenic and yet more arsenic to protect, to insure, to make certain beyond reasonable doubt, the expected production of cotton and cotton seed upon the reduced and intensively cultivated acreage. In short, arsenic in the new specially developed form of calcium arsenate is the levee which permits boll weevil floods to be controlled. Rightly used it is certain in its control on the individual farm.

That the chemical control of the cotton boll weevil is practically certain, profitable and yet difficult, requiring considerable intelligence, close observation, some little training and skill, additional capital and a great deal of industry, including night work, on the part of the cotton grower, is clearly shown by the official bulletins of the Bureau of Entomology of the United States Department of Agriculture, the highest scientific authority in the United States. The bureau unhesitatingly pronounces it "an advanced scientific agricultural discovery."

The highest scientific endorsement is confirmed by the following large scale practical farm operation:

In the Mississippi Delta, on lands once exploited as richer than the Valley of the Nile, there is a cotton-planting company* which controls 60,000 acres, 40,000 of which are in cotton and many in nitrogen-fixing legume crops. It is probably the most scientifically operated plantation, in view of local conditions, in the cotton belt. It has trained officers in every department. The general manager is a man experienced in Federal and State agricultural experimental station work. The president is a remarkably successful business man, an ex-president of the Memphis Chamber of Commerce. After five years of steady, progressive work along chemical lines of control, proving each step by accurate accounting and profits made, this company has this year purchased 1,000 tons of nitrate of soda, 250 tons of calcium arsenate and invested $50,000 in poisoning, or "dusting" machinery to be used on its 40,000 acres of cotton. It is carrying its own insurance, has found that a boll weevil flood can be controlled by a levee (poison) and it has protected its farms by a private levee (an ample supply of poison and appliances). No better practical endorsement than this could be had for the use of nitrogen and arsenic on cotton farms. The figures are illuminating and disclose the magnitude of the operations needed to protect the entire cotton crop. They have found it necessary to take weevil-poisoning out of the hands of their tenant farmers, to organize a weevil-fighting corps including inspectors of the farms and to prorate the expense among the tenants.

It is a crime to leave a camp fire burning in the great forests. There are government fire-fighters in these forests.

We no longer trust individual householders to protect even their own homes, but do it for them.

Private levees have given way to a general system controlled and financed jointly by nation and State.

We have not "begun to fight" the boll weevil. Isn't it time we should? The chemists only can point the way.

*The Delta and Pine Land Co., [illegible]

Current Chemical Patents and Patent Problems

By Lloyd Van Doren, Ph.D.
Consulting Chemist; Patent Attorney, The Chemical Foundation, Inc.

SECURING of patents by American inventors in foreign countries is attended by marked disadvantage in that in most foreign countries procurement of the patent is attended not only with the usual procedure of prosecution and the incidental fees, but by the necessity for the payment of annual taxes and working fees, which taxes and working fees during the life of the patent amount to a very considerable sum, as will be apparent from the accompanying examples, whereas, the grant of patent in the United States is not attended by any additional taxes or working fees.

Great Britain, for a 16-year term, costs $1,074; France, for a 15-year term, costs $532; Germany, for a 15-year term, costs $1,687; Norway, for a 15-year term, costs $337; Italy, for a 15-year term, costs $514; Spain, for a 20-year term, costs $834; Holland, for a 15-year term, costs $935; Switzerland, for a 15-year term, costs a minimum of $308.

Accordingly, in addition to the cost of maintaining a foreign patent the laws in the countries mentioned are prejudicial to the American inventor by reason of the fact that the grant is for a shorter term, and the grants date not from the date of issue, except in Italy and Spain, but from the date on which the application for patent was filed.

This limitation as to term is an important factor when compared with the protection accorded to an inventor under our laws, inasmuch as from 2 to 10 years are required to obtain a foreign grant, which results in a shortening of the effective life of the patent, whereas citizens of foreign countries are able to obtain United States patents for the term of 17 years from the date of issue without further payment of taxes or working fees. Under such grant they obtain an absolute monopoly by an exercise of which, use of the invention in the United States may be entirely prohibited.

Citizens of the United States under reciprocal arrangement are, as a rule, granted a patent for a term of 15 years from the date of filing the application. This in effect makes the life of the patent anywhere from 5 to 12 years, and in order to maintain the grant the inventor must pay taxes and working fees. Most of the countries imposing these conditions have a population which is greatly less than one-half that of this country and whose manufactured products annually are not equivalent in value to those produced in the United States.

On the present basis American inventors receive patent protection in many foreign countries for a period which is only one-half to two-thirds of the period for which a United States patent is granted, and in addition they must pay the taxes hereinbefore referred to. It thus will be seen that a condition exists which necessarily prejudices the rights of American inventors, since they are not able to obtain patent protection in the leading foreign countries which is commensurate with the degree of protection accorded the citizens of those countries under the laws of the United States, and in many instances the taxes and working conditions imposed make the taking out of a foreign patent practically prohibitive to the inventor and a very material burden to the average corporation.

As a direct result of this condition the American inventor is almost solely confined to the United States for his protection. His invention, however, is known, through the publication of his patent, in foreign countries and a foreign inventor, or a foreign corporation, may make certain improvements upon his invention and file an application and obtain a patent on the improvement in the United States, thereby forcing the American inventor to divide his field, and the alien, having the advantage of cheaper production costs, can force him out of the foreign market completely.

Discrimination of the International Convention

The United States is prevented under the terms of the International Convention from passing discriminatory legislation against citizens of any state belonging to the Convention. It would seem that the Convention in this respect acts as a disadvantage to American inventors. It is evident that the advantages pertaining to citizens of the United States through the International Convention are decidedly outweighed by the disadvantages. The logical way out of the predicament undoubtedly lies in suitable legislation. Legislation looking toward the imposition of taxes and working fees upon all inventors, whether foreign or American, would be a material hardship upon an American inventor and would make the taking out of a patent so burdensome as to place it beyond the reach of the average inventor. The result would be to retard industrial development which is dependent upon patent protection.

Legislation must not endanger the patent system in its fundamentals as it exists today and must not impose excessively burdensome conditions upon American inventors, but should impose such conditions upon foreign inventors as would remove the disadvantage under which an American inventor now finds himself with respect to foreign grants.

Action of the Alien Property Custodian

The recent executive order directing the Alien Property Custodian to make immediate demand upon The Chemical Foundation for the return of such patents, applications for patents, trade-marks, copyrights, and other rights transferred to it by the Alien Property Custodian and held in trust by it for the benefit of American Chemistry and Medicine, which formal demand has been made again, has brought prominently to view the necessity for a change in the present patent statutes if American Chemistry and Medicine are to remain independent and not become subservient to a foreign influence.

Neither the Members of Congress who enacted the patent statutes in accordance with our Constitution, nor the founders of the Constitution, conceived that the protection granted to inventors would lead to such a condition of affairs as existed in 1914. But present day Members of Congress are well aware of the influence which was set up, and will again be set up, unless proper precautionary measures are taken. Patents are granted to promote progress and for the benefit of American Industry. Hence, this obligation should be met. If it is not done by the patentee or inventor, why should not one who is willing to assume the responsibility of passing the benefit on to industry and hence to the people, be granted the privilege of so doing?

Benzyl Alcohol Free from Chlorine

Benzyl alcohol, produced by hydrolyzing benzyl chloride with an alkali, is always contaminated with chlorine compounds which render the product unfit for commercial use in perfume manufacture. The property of calcium chloride to yield insoluble crystalline compounds with alcohols is quite in contrast with its slow reaction at ordinary temperature with benzyl alcohol; to obtain any appreciable quantity of the compound a boiling temperature is required.

Ralph E. Montonna, of the Semet-Solway Co., Syracuse, N. Y., employs this property in a process (Patent No. 1,416,859) to obtain pure benzyl alcohol from crude benzyl alcohol whereby the latter is mixed with a chlorine-free solvent of benzyl alcohol and of the impurities, which will not of itself react with calcium chloride, e. g., benzol or toluol. The mass is then dehydrated by treatment with anhydrous sodium carbonate or sulphate. Anhydrous $CaCl_2$ is then added in quantity substantially equal to the benzyl alcohol, combination of which ensues at ordinary temperature with evolution of heat to form a thick pasty mass consisting of the crystalline compound suspended in the solvent used. After standing several hours the mass is filter-pressed and the cake washed with benzol to remove any benzyl chloride or other chlorine containing impurities. The crystalline mass is then hydrolized with water into benzyl alcohol and calcium chloride, the latter dissolving in the water and the former separating as an oily layer which is dehydrated and distilled to give pure benzyl alcohol.

The procedure is summarized as follows:

One hundred part of crude benzyl alcohol, obtained by the hydrolysis of benzyl chloride with an alkali, are dissolved in 200 parts of benzol, dried with 5-10 parts sodium carbonate, filtered and stirred with 100 parts powdered anhydrous calcium chloride. The thick, pasty emulsion which forms with liberation of heat, is allowed to stand for several hours and is then filtered and the filter cake is then washed with approximately 200 parts of benzol.

The filter cake is then stirred with 125 parts of water, the resulting oily layer is separated from the calcium chloride solution, dried with sodium carbonate and then distilled. The resulting alcohol is free from chlorine.

Urea from Lime Nitrogen (Calcium Cyanamid)

Various processes are known for effecting the change of lime-nitrogen into urea by means of acids. The German Patent No. 239,309 describes a process in which dilute acids are used and in which an insoluble salt of lime is formed. According to the German Patents No. 254,474, 256,524 and 257,642 the change is accelerated by the employment of metal-oxides as catalyzer. According to the German Patent No. 285,259 a concentrated solution of cyanamid must be mixed with relatively strong nitric acid. This process has the advantage of leading to solutions of urea which are not diluted. But the previous production of concentrated solutions of cyanamid makes the process more complicated.

If we try in a similar way to add strong nitric acid to a suspension of lime-nitrogen, the reaction takes place in so lively a manner that local decompositions take place. Even with intensive cooling the development of vapours of ammonia and acids cannot be prevented. Similar difficulties arise if we effect the mixture in the inverse succession. Besides the change of lime-nitrogen into urea proceeds very slowly. A surprisingly smooth progress of the reaction is obtained by mixing equivalent quantities of lime-nitrogen and nitric acid of any strength with cooling and stirring in an acidulated solution of calcium nitrate. For it has been found that calcium nitrate in a fairly concentrated solution has a strong catalytic effect in accelerating very much the transformation of lime-nitrogen into urea. If for example 20 kg. of lime-nitrogen are gradually and carefully within 30 minutes brought into 100 kg. of 20 per cent nitric acid, the solution being kept at a temperature not exceeding 20° C., 50 per cent. of the lime-nitrogen is changed into urea after 4 hours. The total amount of lime-nitrogen is changed into urea after 15 hours.

The process for which Patent No. 1,417,277 has been granted to Otto Nydegger and Henry Schellenberg, of Bern, Switzerland, is as follows:

"20 kg. of lime-nitrogen are brought gradually and carefully within 30 minutes into 100 kgs. of a solution of nitrate of lime of [illegible] [illegible] simultaneously 65 kg. of nitric acid of 40 Bé. are added and the solution is kept during the process at a temperature not exceeding 20° C. By this process the whole amount of lime-nitrogen is changed into urea in only 15 minutes. The product of reaction so obtained can be worked up in different ways. The liquid part of it can for example be [illegible] with lime, or can be filtered and evaporated and a [illegible] mixture of urea and nitrate of lime will be obtained. The smaller part of the liquid [illegible] can be used for a new operation instead of the solution of nitrate of lime.

Mercury Nitrate in the Preparation of Nitro-Phenols

It is well known that nitric acid, alone or in the presence of sulphuric acid, acting on aromatic compounds yields nitro derivatives. Thus, benzene, treated with nitric acid alone or with a nitric-sulphuric acid mixture yields nitro-benzene for the first product. It also is well known that nitric acid acting on aromatic substances in the presence of mercury nitrate yields, in addition to the usual nitro derivative, a certain amount of the nitro-hydroxyl or nitrophenolic compounds. Thus, benzene treated with nitric acid in the presence of mercury nitrate yields nitro-benzene and dinitrophenol. This second substance is converted by further treatment with nitric acid into picric acid or trinitrophenol; and the process of treating benzene with nitric acid in the presence of mercury nitrate has been used for the technical preparation of picric acid.

In the processes described it has been customary to use only a relatively small amount of mercury nitrate, for the reason that it has been supposed that the mercury salt acts catalytically and by presence in some way facilitating the oxidation by the nitric acid of the hydrogen atom of the aromatic nucleus to an hydroxyl group. Since it has been supposed that the mercury salt acts catalytically, a small quantity of it has been supposed to be as efficient as a large quantity in leading to the formation of picric acid direct from benzene.

Tenney L. Davis, Somerville, Mass., has discovered that the mercury salt in such reactions does not function as a catalyser but as a real re-agent which enters into the chemical reaction. He found that the larger the amount of mercury salt which is used the greater is the yield of nitrophenol. By treating nitrobenzene, 1.3 dinitrobenzene, 1.3.5 trinitrobenzene, and 2.4.6 trinitrotoluene for several hours with hot strong nitric acid in the presence of a molecular equivalent of mercury nitrate, he demonstrated that the presence of mercury salt does not facilitate the oxidation by means of nitric acid of the hydrogen atom of the aromatic nucleus. In the case of nitrobenzene some nitration occurs, and, along with the nitrobenzene which was recovered there was obtained a considerable quantity of 1.3 dinitrobenzene.

In the case of the other three substances, the original material was recovered unchanged in practically theoretical amount. Trinitrobenzene and trinitrotoluene are readily oxidized by as gentle an oxidizing agent as aqueous potassium ferricyanide, yielding respectively picric acid and trinitrocresole, yet in Mr. Tenney's experiments they were unattacked by prolonged treatment with nitric acid at a boiling temperature in the presence of mercury nitrate. Trinitrotoluene is oxidized by hot nitric-sulphuric acid mixture, or more readily by chornic acid in sulphuric acid solution, to yield trinitrobenzoic acid. As none of this substance was produced in his experiments, Mr. Tenney claims that mercury nitrate does not act catalytically and by presence to facilitate the oxidizing action of nitric acid whether this oxidizing agent is conceived as acting on the hydrogen of the aromatic nucleus or on the hydrogen of the side-chain.

Mr. Tenney discovered that nitric acid and mercury nitrate acting on benzene in the cold produce a complex compound which he isolated in the form of a black solid. This solid is soluble in nitric acid. Treated with hot nitric acid it reacts with it to form oxide of nitrogen, mercury nitrate, and 2.4 dinitrophenol or picric acid according to the condtions of reaction.

The formation of this complex compound requires a molecular proportion of mercury, and the compound when treated vigorously with nitric acid yields a molecular proportion of dinitrophenol or picric acid. The mercury nitrate acts as a real re-agent in the process. The knowledge that it does so makes it possible to carry out the first step of the reaction under conditions which lead exclusively to the formation of the complex compound and so avoid the formation of simple nitro derivatives, like nitrobenzene; and to carry out the second step of the process under conditions which decompose the complex compound into a nitrophenol while they do not at the same time produce its destructive oxidation by the nitric acid.

Mr. Tenney's research has taken the form of a Patent (No. 1,417,368) for the more absolute control of the process for the production of nitrophenols and an increase of their yield which may be used by the Government, or any of its officers or employees in prosecution of work for the Government, or by any other person in the United States, without payment to him of any royalty.

Francis P. Garvan, president, Chemical Foundation, Inc., was awarded the degree of Master of Arts at the Yale commencement exercises.

Personal Items

V. L. Nickle, formerly of the Western Cartridge Co., East Alton, Ills., is now with the J. P. Devine Co., Buffalo, N. Y.

* * *

Dr. L. V. Burton, formerly research chemist, Illinois Canners' Association, is now on the technical staff of Libby, McNeill & Libby, Chicago. Ills.

* * *

Garret H. Barnes, M. I. T. '22, Roslindale, Mass., has been awarded the Goodyear fellowship at the Municipal University of Akron.

* * *

Dr. Arthur J. Hill, department of chemistry, Yale University, has been promoted to an associate professorship in organic chemistry.

* * *

Dr. Robert P. Calvert, formerly of the Arlington, N. J., plant, E. I. du Pont de Nemours & Co., is now chief chemist at the Lompoc, Cal., plant of the Celite Products Co.

* * *

Dr. George K. Burgess, M. I. T. '96, chief, division of metallurgy, Bureau of Standards, has been elected president of the American Society for Testing Materials.

* * *

Dr. Benj. T. Brooks, Mathieson Alkali Works, Inc., has returned from a three-months' trip to England and the Continent, and reports great industrial activity and labor shortage in Germany.

* * *

Edgar M. Ross, formerly chief chemist, Charlotte Chemical Laboratories, Charlotte, N. C., has been appointed chemist and assistant manager McKechnie Bros., Inc., Philadelphia, Pa.

* * *

Fletcher C. Benton, formerly research chemist, Ohio Fuel Supply Co., Utica, Ohio, is a recent accession to the staff of the Pittsburgh Station, U. S. Bureau of Mines.

* * *

Leslie B. Coombs, formerly with the Atlantic Dyestuff Co. at its Newington, N. H., plant, has been appointed superintendent Victory Products Co., Inc., Westboro, Mass.

* * *

Dr. Raymond F. Bacon, consulting chemist, 50 E. 41st St., New York, announces the appointment to his staff of C. H. Kidwell, formerly with the Semet-Solvay Co., Syracuse, N. Y.

* * *

Thos. J. Starkie, formerly of the Thos. J. Starkie Chemical Co., Cleveland, Ohio, is now on the Cleveland staff of the Wishnick-Tumpeer Chemical Co., Chicago, Ills.

* * *

Dr. Roland P. Soule, of the Department of Chemical Engineering, Columbia University, has accepted a position with the Combustion Utilities Corp., 24 State St., New York.

* * *

T. A. Klinefelter, formerly superintendent, Atlantic Terra Cotta Co., Tottenville, Staten Island, is now general manager of the pottery of the J. L. Mott Co., Trenton, N. J.

* * *

Walter R. Hibbard announces his withdrawal from Burt & Hibbard, Inc., consulting chemists, Bridgeport, Conn., to take charge of the laboratories of the Winchester Repeating Arms Co., New Haven, Conn.

Robert K. Painter, formerly of the General Chemical Co., with A. V. Schenck and J. D. Stewart, has established a consulting engineering firm at Auburn, Calif., specializing in mine management and development.

* * *

P. H. Falter, formerly vice-president and general manager, Canadian Electro Products Co., Shawinigan Falls, Quebec, has been appointed vice-president and treasurer, Electric Furnace Construction Co., Philadelphia, Pa.

* * *

Max F. Abbe, after a prolonged retirement because of ill health, will resume business activity as chairman, board of directors, Paul O. Abbe, Inc., manufacturers of disintegrating and sifting machinery, 71-73 Murray street, New York.

* * *

Dr. Earl E. Strachan, Worcester Polytechnic '08, research chemist, National Aniline & Chemical Co., Buffalo, N. Y., has been appointed assistant professor of physical chemistry, Brown University, Providence, R. I.

* * *

Frederick D. Harger, general manager, Mono Corp. of America, is now on the sales staff of Charles J. Tagliabue Mfg. Co., Brooklyn, N. Y., which has taken over all the rights for the manufacture and sale of Mono apparatus in North America.

* * *

W. P. Allen, assistant general manager, Cellulose Products Department, E. O. du Pont de Nemours, succeeds R. R. M. Carpenter, vice-president of the company, in charge of the department during the reorganization of the company's administrative system.

* * *

F. W. Barker, Jr., formerly with chemical division, manufacturing department, National Aniline & Chemical Co., Inc., is now with the Kaumagraph Co., manufacturers of tissue transfers used in trade-marking all varieties of fabrics, 209 West 38th street, New York.

* * *

Dr. A. L. Kibber has resigned his position as chief chemist at Edgewood Arsenal, terminating seven years' connection with the War Department, to become vice-president and chemical director Oil Products Co., 302 North Holliday St., Baltimore, Md.

* * *

Dr. E. D. Leman, chief chemist, U. S. Radium Corp., East Orange, N. J., with his assistant, Marshall Mayes, located by means of an electroscope a lost tube of 10 mg. of radium, valued at $1,000, in the ashes of the incinerator of the Methodist Episcopal Hospital, Brooklyn, N. Y.

* * *

Charles Hanson, chief chemist, Florasynth Laboratories, Inc., Bronx Borough, New York City, together with officers of the company, were apprehended by prohibition enforcement agents who allege that the concern has been selling 50-75 bbls. of denatured alcohol monthly.

* * *

Alfred D. Flinn, secretary, Engineering Foundation, 29 West 39th street, New York, and chairman of the division of engineering, National Research Council, is on a tour of several weeks to the Pacific Coast, to enlist the aid of engineers of the West in a nationwide plan of industrial research in which the Foundation, the Council, government departments and the industries will link their efforts.

Industrial Notes

Belle Alkali Co., Belle, W. Va., is providing additional facilities for caustic soda and chlorine production in a 2-story structure, 50 x100, to cost $100,000.

* * *

The International Carbon Corp., 200 Fifth Avenue, New York, has under way plans for the construction of a plant in France for the production of decolorizing agents from lignite.

* * *

The Carborundum Co., Niagara Falls, N. Y., will market its anti-slip tile through the American Abrasive Metals Co., 50 Church St., New York, which has been appointed United States sales agents.

* * *

The arrival at Syracuse June 30 of two barges laden with 800 tons of German potash is said to be the first German cargo ever carried on the New York State barge canal. It is claimed that a saving of $2 per ton is made by the use of the canal route.

* * *

The Chesebrough Mfg. Co., 17 State St., New York, manufacturers of petroleum products, will establish a plant at McKees Rocks, Pa., which will cover a 14-acre tract; initial work on the construction of the first unit of a group of manufacturing buildings is now under way.

* * *

Retsof Mining Co., Retsof, N. Y., has awarded contract to the John W. Cowper Co., Buffalo, N. Y., for a one- and two-story salt mining and refining plant, estimated to cost about $1,000,000, including machinery, power house, etc. T. F. Courthope, Retsof, is the company engineer.

* * *

The Shasta Zinc & Copper Co., Winthrop, Cal., has started the production of zinc oxide in the first plant of its kind on the Pacific coast; capacity 1,000 tons per month. Officers and directors are: D. C. Jacking, president; Walter Arnstein, vice-president; and John Black, E. B. Braden, Charles Hayden, R. C. Newland, A. Asberg and W. W. Crocker, directors.

* * *

Empire Fuel Products Corp., Adam H. Davidson, general manager, Dallas, Texas, has acquired 1,000 acres of lignite land near Rockdale, Texas, and a 1,000-acre tract of the Santa Fe Lignite Co., in addition to 3,000 acres of lignite property in Limestone Co. The company will produce briquette and recover by-products. Construction of the first unit of a distillation and briquetting installation is planned.

* * *

The American Smelting & Refining Co., 120 Broadway, New York, plans to build a by-product coke plat at Coahuila, in the district of Sabinas, Mexico. Construction work will not be begun until official authorization has been received from the Mexican Government and an agreement reached regarding taxation. The plant will cost about $7,000,000 and will include a model village with workmen's homes.

* * *

The establishment in New England of the industry of petroleum refining, working on foreign crude oils, was hailed as an example of regional industrial self-sufficiency, which now is matched by the initial operation at Llandarcy, Wales, of the petroleum refinery of the Anglo-Persian Oil Co. working on crudes carried 6,000 miles from the company's Persian fields. Present daily capacity is 10,000 bbl., which it is planned to increase.

Restricted Brazilian imports of caustic soda during the war prompted government encouragement of domestic manufacture with the result that a plant was built at Rio Janeiro with a daily output, reported by the U. S. commercial attaché, of 5,000 kilos of 76° caustic. Brazil imported in 1919, 9,892 tons; in 1920, 12,136 tons and in 1921, 2,899 tons of caustic soda. While the decline noted is due chiefly to depression, there can be no doubt that local manufacture, if efficiently conducted, will work to the detriment of American caustic soda exports to Brazil.

* * *

The proposal of the Aluminum Co. of America, 120 Broadway, New York, to lease the real estate and plant of Aluminum Manufacturers, Inc., for a term of 25 years from July 1, 1922, was confirmed by the stockholders of the latter corporation on June 29. The proposal also embraced the acquirement of the benefit of patents and trade marks during the period, the inventory at market value July 1, the capital stock of the Aluminum Die Casting Corp. and the Aluminum Screw Machinery Products Co., owned by the lessor, and the option of purchase not exceeding $708,700 of the preferred stock at $65 and dividends within one year.

* * *

The Compagnie Nationale de Matières Colorantes et de Produits Chimiques, which manufactures two-thirds of the total French output of dyes and allied products, has a capital of 100,000,000 francs, and in the current year is paying in dividends over 5,000,000 francs. Statistics of the French Dye Manufacturers' and Consumers' Union show that of the 10,000 tons of dye products used by France in 1920 as much as 5,739 tons was imported. Consumption fell to 7,000 tons in 1921 and the quantity imported was only 1,172 tons. The company has devoted much attention during the past twelve months to extending its range of colors, for which most of the necessary plant has been erected.

* * *

Control of the Heyden Chemical Co. of America acquired from the Alien Property Custodian in 1918 by Allan A. Ryan, has passed into the hands of Bernard R. Armour, president, American Aniline Products, Inc., who has acquired from Mr. Ryan the 500,000-share controlling interest. The corporation is one of the principal producers of salicylic acid and salicylates, but has been inactive since a recent fire at its plant at Garfield, N. J. Present officers comprise: Bernard R. Armour, president; James Branigan, vice-president; George L. Armour, treasurer; Geo. F. Lewis, secretary. Frederick Chamberlain, former president, is chairman of the board of directors whose personnel at present is temporary.

FOR SALE

Kjeldahl digestion shelf, with six burners, distilling apparatus, wall form, complete with connecting bulbs and flasks. List price, $77.90; sale price, $44.50. Address, Bennett's Laboratory, Tacoma, Wash.

POSITION WANTED

EXPERIENCED Analytical Chemist Metallurgist desires connection with high grade, up-to-date engineering or manufacturing concern. Experienced in the fabrication, control, testing and valuation of commercial material. Eight years in charge of a government laboratory connected with industrial, naval and engineering work. Age 35. Address D 7, care of Chemical Age.

CHEMICAL
AGE
A CONSOLIDATION of THE CHEMICAL ENGINEER and CHEMICAL AGE
LLOYD LAMBORN, *Editor*

VOLUME 30 NEW YORK, AUGUST, 1922 NUMBER 8

More Chemists and the Service of Penn. State College in Their Production

By Dr. John M. Thomas
President, Pennsylvania State College

THE primary endeavor of the College or University in industrial education is the professional training of young men, who have had at least a high school course, in the technical subjects which will equip them for positions of responsibility and leadership in industrial pursuits. With which professional training must be associated such general and liberal culture as will make them citizens of influence and men of mind sufficient to deal successfully in large affairs. It is to the interest of the commonwealth that such technical education be provided for all youth who prove themselves competent to undergo the severe discipline necessary to adequate training for the practice of the technical professions.

DR. JOHN M. THOMAS
President, Pennsylvania State College.

Never Too Many Well-Trained Technical Men

There are not likely to be too many masters and directors of industry. The higher the rise of man, the more ample and refined his life, the greater will be the need of men who are skilled in turning the natural resources and products of the earth into materials for human use and enjoyment. Savagery had no need of the technical man, but civilization has, and the higher the civilization the more technically trained men will be needed and the more skillful they will be required to be.

There is a limit to the need of a commonwealth for physicians or clergymen. Enough may be provided to respond to all the sick calls and to preach to the people. But there is no limit to the need of men to construct and operate industrial plants, for the reason that every real master of industry creates the need of many others.

Alexander Bell invented the telephone, and today a million engineers are required to apply his discovery to the wants of the people. Thomas A. Edison invented the electric light, and every city and town in the civilized world began calling for men educated in industry to make the invention available for common use. Nor is it alone the men of genius whose toil in the creation of industry calls forth the toil of others. Every earnest and energetic master of a shop or factory starts a demand for the products of others, which in turn send out their calls for the work of other men, and those summon others to creative activity, and there is no limit to the succession.

Employment for the millions of the increasing population of the earth waits the coming of the men of skill and training who can organize and control and by their power in leadership turn the activities of many into useful channels.

In a little New England town years ago, a crossroads hamlet, with a blacksmith shop, a store or two and a run down tavern, lived a Yankee who conceived the design of a machine tool. Instead of selling his ideas to a promoter in Boston, the Yankee started making his machine in a little shop. The shop grew into a factory, where is now one of the most prosperous industries of New England, and the crossroads hamlet is a thriving city, the most rapidly growing in the State in which it is located.

You can not have too many men like that inventive Yankee. You can not train too many boys of mechanical genius in the principles of machine design and the application of power to useful construction. You cannot train too many young men of insatiable curiosity in the scientific principles of the structure and behavior of matter and in skill to apply to manufacture this specialized knowledge. Every skilled organizer and director of industry you produce will provide opportunity for many others, and now and then you will find a genius who will build a great city or make a whole countryside throb with the life of a new industry.

Money expended in industrial education of the highest grade is the wisest investment any commonwealth can make. It is the grossest improvidence and shortsightedness not to offer to the youth of the state who are ambitious for education into leadership in industry, the best advantages they can use, and to offer those advantages to every youth who has the ambition and courage to seek them.

The Example of Massachusetts and the Dereliction of Pennsylvania

In Massachusetts there is a technical institute with buildings and equipment valued at $10,235,000 and an endowment of $9,616,000 to support its work. On a magnificent site by the Charles River its beautiful buildings welcome students from every country in the world to take advantage of the highest grades of technical education anywhere to be found.

In Pennsylvania there are worthy technical institutions, but in the only school of engineering owned by the State a devoted and able Faculty is giving instruction in buildings which cost the state $660,000 with equipment valued at $300,000, and the only funds available for maintenance are a grossly inadequte State appropriation. The main building burned to the ground three years ago, and not yet have we been able to secure an appropriation to replace it. Notwithstanding, we have more students than we know what to do with. During the past three years, an average of 1,000 each Fall have been denied admission; between 50 and 60 accepted applicants in each new class elect to study either "straight" or industrial chemistry, which is only a part of those seeking professional education in chemistry. In view of the tremendous possibilities of development of industry in Pennsylvania, that statement seems to me to imply almost criminal short-sightedness and economic waste.

There should be one center of higher industrial training in the State entirely under the control of the people of the State and administered solely with an eye to the general welfare. Private interests may support their own institutions and direct their activities in accordance with the views of those who contribute to them. There are not likely to be too many such institutions, and it is not probable that they will be supported too generously.

But the people as a whole have a right to one institution where no man's dollars influence policies and undertakings, free and open to all alike, and where the boy from the humblest home may have equal chance with the most favored in advantages equal to the worthiest and the best. The Commonwealth of Pennsylvania will not do her duty by her boys or by herself until such an institution is adequately and generously provided and equipped in the State's own University.

Taking Technical Instruction to the Manufacturing Plant

But industrial education can not be presented fully from the point of view of the University or Technical Institute without reference to the secondary endeavor of the institution, which is educational extension in the trades and industries. Especially is this true of the State institution which is bound by the principles of its foundation and by the obligation of its public support to regard the whole territory of the State as its campus and its field of service.

The Pennsylvania State College began extension work in 1906 and was thus one of the pioneers in this form of education. It was one of the first to displace the formal lecture with syllabi and outside reading by the more practical shop class with specially prepared outline texts. Strange as it may now seem, the attitude of employers and superintendents ten years ago was not cordial toward the offer of educational advantages to the men. Representatives from the college seeking to organize classes usually met with indifference, sometimes with rebuffs, and much tact and persuasion were necessary to gain a foothold. It was not until 1910 that the first class was organized in Williamsport with the cooperation of the School Board. It was an evening class in Shop Drawing and was conducted in the High School. The following year an apprentice school was organized in the Altoona shops of the Pennsylvania Railroad, conducted by an instructor in electrical engineering from the college.

A Belated Campaign

Just why the great State of Pennsylvania, with its almost limitless natural resources and productivity, permits the situation here set forth to continue is a problem that has bounded in recent months from State to National prominence. Every State south and west of Pennsylvania has established its own free State University as the capstone to its system of public education. Not a cent of tuition ever has been charged Pennsylvania's young men and women who succeed in their desire to attend her State College It is unfair to our youth and reprehensible to our commonwealth figuratively to compel one to stand at the college entrance each opening day in the Fall and turn away over 50 per cent. of those who laudably seek the benefit of the state's bounty in the priceless possession of education.

With the cooperation of its alumni, the faculty and officials of Pennsylvania State College have entered upon a campaign to raise $2,000,000 to provide needed buildings for instruction and for student health and welfare, in which we hope to make our status so well understood by the American people that the people of our State no longer will permit the denial of adequate public support for the planned development of this institution and its establishment as the State University.

Our Service to Chemical Industry

Our human contributions to this field well entitle us to the commendation, "Well done, thou good and faithful servant," in confirmation of which we submit our special register of chemical alumni and cite industrial attainments in chemistry that range from the doubling of the state's potato yields in the past four years, to war-time toxic gas production by one of our finest men.

In 1902, we graduated 6 chemists; in 1912, 26; and in 1922, 44. In 1906 we gave instruction in chemistry to 470 students; in 1921, to 1690. In the 67 years of the college's existence over 12,000 students have studied chemistry here. Under the administration through 32 years of Dr. George Gilbert Pond, chemical instruction became the most inspiring course in the college curricula. A few weeks after his death in May, 1920, by his prearrangement, a gold watch was presented to the 10,000th student enrolled in his classes, and his memory is cherished in the name of our new chemical laboratory building. Pennsylvania State College has graduated more chemists and industrial chemists (chemical engineers) than have all other institutions of technical education in Pennsylvania and this without any sacrifice of quality. Today there are 22 members of the instructing staff in chemistry.

Our chemically trained men make good. They are all over the world and are all in process of growth. In submitting the names of some by way of samples I know I will stir the pride of every Penn State chemist. Dr. William H. Walker gives us the benefit of his experience as a member of our board. John Fields, editor, *Oklahoma Farmer*, is a candidate for Governor of that State. Harry C. Peffer is professor of chemical engineering at Purdue University. Francis J. Pond is professor of chemistry at Stevens Institute. Jerome J. Morgan is assistant professor of chemical engineering at Columbia University. Harry J. Patterson is director of the Maryland Agricultural Experiment Station. G. R. Wieland is paleontologist, Osborne Laboratory, New Haven. George M. Norman is chemical director, Hercules Powder Co. William H. Teas is president, Marion Extract Co., Teas, Va. Ambrose N. Diehl is general superintendent, Duquesne Steel Works and Blast Furnaces of the Carnegie Steel Co. This list is complete in our register of chemical graduates.

George Gilbert Pond Chemical Laboratory, Pennsylvania State College

The Chemistry Buildings

The physical equipment for future instruction in chemistry at the Pennsylvania State College will be embraced in the extension of the George Gilbert Pond Chemical Laboratories.

The building as it now stands represents the lower left hand leg of what will eventually be an H-shaped structural group, all of which will be devoted to the needs of the chemistry department of the Science School. It is an imposing structure of white stone, with large laboratories on each of the three floors. These are now used for the instruction of advanced classes.

The development plan of the college calls for this group to be the central figure in a large quadrangle to be known as the Science School Group. It will be advantageously located in the central portion of the campus, and by following the style of architecture already started, it will be made into one of the most attractive groups on the entire Penn State campus.

Realization of this splendid equipment to carry on the work so well established by the late Dean Pond depends upon financial support from Pennsylvania State Legislature and the energy which alumni and friends of Penn State display in obtaining adequate recognition for this State institution of higher education.

More chemists could be trained at Penn State if accommodations were provided for more students. The alumni have long felt the need for necessary expansion and development and accordingly are out to provide additions to the dormitories for men that were started early in August with State funds. They will also endeavor to erect dormitories for women students, physical education buildings for both men and women, and a Students' Union building that will serve as a social hall and student activities headquarters. These, with the new hospital building, will provide needed student health and welfare facilities, and the next State Legislature will be asked to begin a program for the erection of class and laboratory buildings as they are needed.

The college architects have drawn up a plan of expansion for the Pennsylvania State College for the accommodation of an enrollment of 10,000 students, which is three times the present attendance. The development to an institution of this size will of necessity cover a period of years, and to make such an institution take the place that it should in the forefront of American State universities, an effort will be made in the near future to have the name of the institution changed to the Pennsylvania State University.

Penn State is now a university in everything but name; it is official recognition as the State University that the College now desires that it may have the prestige and added interest of the people that it would demand under that name.

The Massachusetts Legislature has appropriated $300,000 for the construction of a new chemical laboratory building at the State Agricultural College, Amherst, Mass., to be named the Goessman Laboratory in honor of Charles A. Goessman, the college's first professor of chemistry.The building will be of brick, of fire-proof construction, 195 feet long and 56 feet deep, with an above-ground basement, and two stories above, surmounted by a pitch roof with dormer windows.

The Senate's refusal by a non-partisan vote of 32 to 30 to promote the establishment of a domestic potash industry by the granting of a bonus or bounty on its output is additional evidence of growing recognition of the fact that a return to normal conditions does not lie in the way of resort to uneconomic means to bolster up industry. However desirable production self-sufficiency may be from a national standpoint, or even that measure of production that would serve as a price control of alien agencies that, as too well known, will take advantage of their monopoly position, the procedure proposed is declared to be not only un-American and unconstitutional, but obstructive of that economic readjustment which must embrace the world, if a return to normalcy is to be assured.

In the attainment of economic equilibrium, always in process, the smaller interest, however much may be the loss in capital or sentiment, is merged into the greater.

A Plea for Tax-Free Scientific Instruments

By Herman A. Holz

THE new tariff act is to put a tax on science and research in the United States. The privilege of duty free importations of scientific instruments which our universities, colleges and other institutions of learning and research has enjoyed under the previous tariff acts is to be canceled and a special high duty is proposed on all instruments and appliances for laboratory use.

The revenue on imported scientific instruments cannot possibly amount to more than a few hundred thousand dollars, and there is no "scientific instrument industry" in the United States that needs protection. The building of scientific instruments is never an "industry"; it is an art. The design of a scientific instrument is based upon the ingenuity of some scientist who works the scientist has conceived and developed the basic thethe scientist has conceived and developed the basis theory on which the the instrument is to operate he then usually is assisted by an instrument maker in working out the details of design of an apparatus which permits the application of the particular theory to practice, thus permitting the use of an advance in science to an improvement of the methods in the laboratories of the country.

If the American instrument makers need protection for any particular American inventions and designs they easily can obtain it through patents. If some European scientist develops a new instrument that is of importance to American courses of study and to our industry, no tariff will keep it out. A high tariff on laboratory apparatus will simply mean a tax and penalty on our own scientific life and a heavy burden to the research departments of our industrial manufacturing plants. Quite often valuable European inventions are patented in the United States, so that a high duty on the products of these inventions will in no way help to build up an American instrument "industry," but only will result in retarding American scientific and technical progress.

The importance of systematic research work, in the development of new processes, in the improvement of old processes of manufacture, in the utilization of natural resources and by-products, in the application of scientific principles to the benefit of our industries, has been fully appreciated in this country only during recent years. In Europe, and particularly in Germany, it has been appreciated and applied—out of sheer necessity—since half a century.

Scientific research, interrupted in Europe during the war, is now being carried on over there more energetically than ever. A chain of special research institutions, one for every important industry, has been established by the new Republic of Germany, as efficient and active as the old universities under the monarchic regime ever have been. The industrial life of the new republic, its very existence, will depend largely upon the success of these research institutions. It is of the greatest importance to the United States to co-operate with Europe, and especially with Germany, along the lines of interchange of scientific information, to co-operate in the solution of research problems that affect equally all nations and to eliminate unnecessary duplication of efforts in scientific research. It is the height of folly to increase the expense of scientific equipment to our great institutions of learning, especially since their resources already have been sadly depleted during recent years.

Before the war nearly all our great universities spent the largest part of their funds for bricks, taking special pride in the wonderful buildings and their beautiful architecture. Upon close study it was often found that in the laboratories important instruments were lacking on account of shortage of funds. In Europe the opposite policy has always prevailed; we find the most wonderful scientific equipment in the most unpretentious buildings. We have to catch up in the equipment of our scientific laboratories, and to hamper this progress would be suicidal.

One important item among the "laboratory apparatus," the importation of which is to be penalized by the new tariff, is machinery and instruments for testing and controlling the quality of materials which our industrial plants produce, such as metals and alloys, textiles, paper, leather, oils, etc. In this field of testing apparatus Europe is leading, and an American "industry" in such devices hardly exists; the two small plants manufacturing such devices over here can easily protect themselves by patents. There are hundreds of instrument shops all over Europe making and constantly developing valuable testing devices which the American industry sorely needs to maintain its high quality standard of manufactured products. To assess a high duty on such apparatus will have the result that their introduction and use in American practice will be retarded and this will put the entire American industry into a very disadvantageous position. Thus, on one side, we would have a revenue from duties of a few hundred thousand dollars, and on the other hand a damage to our industries of many millions.

The American scientists and engineers insist rightly upon the very highest quality of the instruments and appliances which they use, just as a good workingman insists upon using the best tools that are being made. The American experts will, therefore, always prefer to draw upon every country of the world for the best instruments which that particular country has to offer; Austrian microscopes, German refractometers, Swiss testing machines, British spectrometers, etc. The new tariff would therefore penalize particularly those discriminating scientists and engineers who use the best tools in their work and thereby obtain the best results.

In the long run a high tariff on scientific instruments and the cancellation of the privilege of duty-free importations of our universities and research institutions must have a detrimental effect on our entire scientific and technical progress. It is this progress, more than anything else, that we will need during coming years in order to maintain our present position in the technical and commercial affairs of the world.

The cost of technical education and of scientific research must be decreased, not increased. By putting all scientific instruments, testing apparatus, models, charts, etc., on the "free list," great assistance would be rendered to our industry as a whole, and our engineers, scientists and students would then have ready access to scientific progress made in any corner of the globe and would be in a position to apply it promptly to the benefit of the nation.

The sale of the plant of the American Potash Co. at Antioch, Neb., by the referee in bankruptcy to Charles Hiatt, W. F. Sharp and F. R. Easterday has been consummated. The consideration was $12,000 cash, assumption of accrued taxes, and mortgages of over $211,000.

Some Conditions of the Chemist's Work

By George L. O'Brien
Plant Manager, O'Brien Varnish Company, South Bend, Ind.

THE opportunities of the chemist in a manufacturing plant vary with the product made and are determined by the capacity of the chemist. The degree of perfection that the product has attained and commercial conditions as affected by competition profoundly influence the chemist's initiative and determine very often the directions of his service.

Capacity Determines the Chemist's Opportunities

To say that the chemist's opportunities are determined by his capacity opens up the whole subject of the chemist's work in the plant. If his initiative does not go beyond the accuracy of analysis, little can be expected of him in the way of constructive work in the responsibilities of production. To the chemically trained man of executive capacity, with the faculty of working harmoniously with administrative men, opportunity soon comes to get the run of the plant and with it the rapid development of ability not only to correct bad practice but to recognize conditions that lead to it. In such work the man leaves to others the details of chemical control work of the laboratory and becomes a technical director, and may be called such, or a foreman, or a superintendent of production, where the size of the plant warrants the division of responsibility of production between technical supervision of procedure and factory discipline or management.

The field for the chemist in plant routine is determined as much by the alertness of administrative men of the organization as it is by the capacity of the chemist himself. Where these men, in more direct touch with markets than the plant chemist, are keen to learn of the excellence of competing goods and, being closer to the sales end, have knowledge of production costs, their relation to the chemist becomes entirely executive and the chemist does what he is told to provide men of this calibre with information whereby they may match or surpass competing goods in quality and price.

Thus it is that the chemist's opportunities for self-development, i. e., opportunities for advancement, are determined as often by the calibre of his colleagues as it is by his own capacity. Where the former is low and the latter are alert we may expect rapid advancement of the plant chemist. Where the reverse prevails, you certainly will find the chemist complaining about having little or no chance for advancement, i. e., for receiving more pay to meet his more rapidly growing needs, a condition common to all but of peculiar distress to the educated man in industry.

Where the chemist's colleagues are of equal or superior alertness in these attributes unrelated to book-learning, you can see that upon the chemist is imposed a handicap which he must overcome by corresponding application, in that competition for recognition and advancement that prevails in every well regulated organization.

It often is true that, where administrative plant men are chemically trained, the disposition is to confine the laboratory chemist to laboratory work where in the direction or performance of control work, he supplies his superiors with information essential to the maintenance and improvement of quality of product or to the lessening of costs of production. Under such conditions it is regrettable that resentment often is aroused by the laboratory chemist who, under the urge to satisfy an insatiable curiosity, transgresses upon the domain of the chemically trained man in the plant. Where this man is not chemically trained he welcomes contact with the laboratory chemist in that interchange of information whereby each profits.

The size of the plant, whether or not the owners or executives are chemically trained, the system of plant management and the breadth of mind of the administrative chief, determine the movement of the chemist from the laboratory to the plant, from one department of the plant to another and from one branch of the business to another, and in which movement the outstanding determinant is the capacity of the man himself.

The Ideal Plant Chemist

The ideal plant chemist, if we can imagine such a creature, is a catalytic agent increasing the resourcefulness of all with whom he comes in contact. Out of the fullness of his knowledge of the properties of the materials under process and of his practical familiarity with procedure, he should be an unfailing source of new ideas to improve or cheapen manufacture. He should be hospitable to new ideas from whatever source looking to the same ends, examining them to determine their utility. His knowledge of the trade and of his competitors' progress should lead him to suggest and to try out new and desirable products. In his control work of plant procedure his great responsibility is to standardize production that there may be a steady flow of up-to-standard goods uninterrupted by the lapses of careless help.

Of two plant chemists, the abler one is he who sets the pace for the sales manager and does not follow in the wake of a competitor's accomplishments. To have the sales manager say that a given quality of competing goods must be met if business is to be had, is quite distinct from the demonstration by the plant chemist, who fills out to the responsibilities of a technical director, to this important individual that superior quality is attained without increase of cost. In the latter case, the chemist has the sales manager on the run. In the former the sales manager has an "alibi" for reduced business, and the "chief" an added responsibility to find a man that will "key-up" production. While the chemist may not be a "second rater," he approaches dangerously this classification if in his responsibility for quality of product he permits the competitor with no advantage in access to raw materials to set the standards of economies and quality.

Ordinarily the sales department dominates production, for volume of output and quality are determined by what can be sold. Clearly he is the exceptional chemist who can reverse this relation, but such should be the ideal of every production chemist. This responsibility is a privilege earned only by the display of capacity, and this indispensable factor in manufacture everybody is searching for.

Deficiencies of the Plant Chemist

As a plant manager I find that the chemist leaves much to be desired in the attainment of this ideal of capacity. Where his indispensability lies in the fullness of his knowledge, his outstanding deficiency flows from his lack of it—of thoroughness of education in chemical and related lines. Not only must he know chemistry but he must have familiarity with modern thought and development in his chosen field, and particularly in the type of manufacture in which he is employed.

In the specialization of functions in modern manufacture the chemist's initial duties in industry are clearly defined. These ordinarily are chemical analysis. All investigation and research rest on the foundation of accurate knowledge of composition and behavior, in the acquirement of which rapidity and accuracy are required of the analyst. He must be thoroughly familiar with analytical methods, particularly those used in the field of his employment; his manipulation in accuracy and rapidity, to permit the information thus derived to have its maximum value, must be coordinated with soundness of interpretation of the results.

Any plant executive who has had to rely on the work of his own chemists or on commercial laboratories is familiar with the often appalling lack of agreement in simple analytical determinations. In addition to positive knowledge that the chemist is wrong is a presumption, too often strongly confirmed, of inaccuracy and carelessness, to condemn the work of analytical chemists.

A second great deficiency of the works chemist has been in the faculty of salesmanship. This by no means is a vague characterization; it means the inculcation of the confidence of the various grades of the plant's administrative personnel, e. g., the general manager, the plant superintendent and the various foremen, in the chemist's ability as displayed, for example, in his sound understanding of manufacturing procedure and of the practicability of his suggestions looking to the correction of mistakes or the improvement of settled practice. It embraces making his instructions clearly understood and encouraging that measure of teamwork on the part of humble help, without which the working out of meritorious ideas often is abandoned. Without this faculty of salesmanship, which has its roots in character, capacity and the fine art of making friends, the cordial co-operation of brains and manual labor will be difficult to establish in the factory organization.

Authority is the Reward of Capacity

In the recognition of capacity in the work of the plant, too often it is true that the chemist seeks authority rather than responsibility. Power everywhere flows to the man who will assume responsibility for this will to do is based on a self-confidence that commands respect and instills a disposition to obey instructions. The man who insists upon personal authority in order to get work done neglects the prime requisite of progress which is personal responsibility for results. Where he eagerly assumes this, the chemist is sure to inspire that degree of loyalty on the part of the help which by no means would come from the uncertain endowment of disciplinary power. Where you find the chemist with everyone in the plant eager to help him, you will find a man who commands respect because of demonstrated ability and of that valuable faculty of making friends. Consideration of the other man's viewpoint and sharing the pride that every man has in good work well done do more to develop teamwork than any appeal to authority.

In any discussion of the plant chemist I would not omit the responsibility of the plant manager for maintaining conditions that will bring out the best in the chemist. This embraces providing the chemist with all necessary facilities for his work which may include freedom from distractions as well as all necessary equipment and co-operation. The plant manager welcomes new ideas [illegible]. The chemist should be warned that his submission of impracticable ideas is a powerful deterrent to that mutual confidence that should exist between these two factors in the plant.

The trinity before which the plant organization worships is (1) reduction of costs of production, (2) increase of output and (3) improvement of quality. The most devout should be he whose scientific training is expected to qualify him as the most fruitful source of suggestions. If he is backward in these utilitarian devotions we must not be surprised that frequently fault is found with the factory chemist.

American Magnesium Production

The American Magnesium Corp., Niagara Falls, N. Y., produced 10,044 lbs. of metallic magnesium from California magnesite in 1921, a considerable falling off of the previous year's production. In 1921, German imports of the metal amounted to 39,913 lbs., an increase of 10,638 lbs. over 1920. Germany controls within its borders the necessary raw materials, and with its depreciated currency can undersell in any market. The American Magnesium Corp. claims to be able to produce commercial magnesium 99.98 per cent pure. The president of the corporation, in commenting on the developments in 1921 to the U. S. Geological Survey, says:

"Details in the process of producing metallic magnesium have been practically solved, and the bulk of the work accomplished during the year has been in the field of special problems incident to the commercializing of partly manufactured forms, such as castings, sheet, rod, tubing, wire, and forgings. Each of these forms requires a special technique, as the working of magnesium, though not inherently more difficult than that of other metals, requires wide and detailed research.

"Preliminary work toward the necessary introductory selling effort has already been started in the aviation field, in textile machinery, instruments of precision, drafting tools, the reciprocating parts of automotive engines, typewriters, and sewing machines. In each application of magnesium a special study of the requirements must be made, and only after repeated trials can the qualities of magnesium be properly developd to suit each individual condition. Experimental work in alloys is well along, and results that are in general comparable to the average results obtained from aluminum alloys are already indicated. By alloys is to be understood metals containing more than 85 per cent of magnesium.

"There is not sufficient demand for metallic magnesium in this country, if its use is confined to deoxidation, to minor alloys, and to pyritechnics, to warrant any considerable investment in the manufacture of the metal. Only by the development of its use as a structural material in such ways as those mentioned above can the industry succeed. The characteristics of the metal make it so essential that the demand for it is certain to increase if sufficient time and money are available, with a reasonable freedom from foreign competition."

Hattiesburg Pine Oils Co., Hattiesburg, Miss., has been organized to utilize pine stumps and waste for the manufacture of turpentine, pine oils, tar and rosin. A plant costing approximately $180,000 will be erected. [illegible] West is construction engineer.

Fuel Costs and the Plant Executive

RESTRICTION of coal supplies, resulting from the prevailing strike of miners to enforce a wage scale and operating conditions repugnant to present-day developments in industry, is limiting production and increasing the costs of all manufactured goods, thereby aggravating a situation which is the basis of the objection to wage reduction. Present conditions, therefore, not only emphasize the importance of fuel in the factory economy, but throw added responsibility upon the production manager that its consumption shall be with the maximum efficiency, a condition too greatly neglected when nothing disturbs the even tenor of operation.

The industrial plant in which the executive has not materially cut production costs is indeed the exception, says the *Textile World*. It has been a long time since more sweeping cost-cutting and burden-reducing campaigns have been carried on in industry than are now being waged. Necessity demands it. The power plant is a place where cost cutting effort is well worth while. The following sets forth effective ways of reducing power costs, as the executive may well understand them.

Low Average Boiler Efficiency

Fuel constitutes between 50 and 75 per cent of the cost of power in the industrial plant. The greatest source of power cost therefore is in the fuel. The most wasteful part of the power plant is the boiler room where the fuel is consumed. Boiler efficiency expresses the completeness with which the boiler utilizes the heat (fuel) supplied to it. This efficiency has reached 82 per cent in well equipped, intelligently operated plants. In the average industrial power plant it is more nearly an average of 55 per cent.

This means that 45 per cent of the fuel bought has not been utilized. Of this amount 18 per cent may be considered as an unpreventable loss, 27 as preventable. This loss is a heat loss. For all commercial considerations the money loss it represents may be considered as having a direct relation to it.

If a coal has a heat value of 12,000 British thermal units per pound, a fair average for textile mills the country over, a preventable loss of 27 per cent means an avoidable waste of 6,480,000 B. t. u. per ton. The boiler horsepower hour is equivalent to 970.4 x 34.5= 33.479 B. t. u. Therefore, the avoidable waste per ton of coal consumed is

6,480,000÷33,429=190 boiler horsepower hours.

Commercially, the cost of evaporating 1,000 pounds of water in the boiler, from and at 212° F., is the common way to express the evaporative performance of a steam boiler. For many years, and up until the war, the cost of coal per 1,000 pounds of water evaporated in representative progressive New England textile mills where power engineering has long been outstanding for economy, was about 21 cents.

An evaporation of 8 pounds of water per pound of coal as fired is good performance day in and day out. At this rate, and with coal say at $8 per ton, the coal cost for evaporating 1,000 pounds of water is

1000÷8 x 0.4c. per lb. for coal=50c.

Considering that labor, supplies and all other costs have increased almost proportionately, the reasons for cost-cutting are over twice as urgent as before the war. But, more than this by far is that competition after "normalcy" is reached demands lower costs.

It is a well conducted central power station where the coal consumed per kilowatt hour is less than 4 pounds over the year's operation; some get down to 2 pounds it is true, but these are exceptional. Yet in these stations excellent engineering talent supervises operation, highly efficient equipment is the rule, and the load conditions, which materially affect economy, are good. The usual industrial power plant is not so fortunate in the power generating end as the central station, though it is usually better off as to power distribution costs. But if the reasonable figure of 5 pounds of coal per horsepower hour over the year is taken as a basis for estimating, it will be clear that a cost cutting campaign here is worth all the effort given to it.

What the Executive Can Do

Now what can the executive do about it? First, he must ascertain that those responsible for the operation of the power plant are capable, safe men. Presumably he knows this, but if he does not there is no way of telling other than by an investigation of the engineer's antecedents, comparison of the power costs, if known, with those in other similar plants, if such good fortune is the executive's, or by calling in the consulting engineer to make a rough survey and report. A half-hour's conversation between the plant chief engineer and the consulting engineer will convince the latter how well the former measures up to his job.

Secondly, the executive must demand that a practicable system of record keeping and record analyses be started, if not already a part of plant routine. No engineer, no executive, can intelligently guide and administer power plant performance without keeping daily record of what the plant is doing. To try to do so is to fail, just as the company itself would fail if it kept and studied no records of production, sales and distribution of the products manufactured.

The record forms in the average industrial power plant are so laden with non-essential items called for, that half of those which are essential are seldom entered on the form. The engineer is no more responsive to such forms than any other head about the works. Report forms, daily, weekly or monthly, should call for essential, brass-tack data only. Forms that are suited to one plant may not be suited to another apparently similar. There are, however, basic items which should be entered in every power plant, viz., (1) coal fired to the boilers, in pounds; (2) weight of water evaporated, in pounds; (3) hours every prime mover and boiler are in service; (4) ampere or watt-hour meter readings; (5) oils, grease, and supplies used by the power plant only; (6) steam, water, and electricity, supplied to various parts or departments of the mill. All the foregoing is tied to some time interval of course.

If these are recorded, and daily recording pressure and temperature charts for important services are filled with these reports, the means are at hand for daily, weekly or monthly diagnosing the power plant performance. There is no end to the data that may be worked up from these basic data.

Provide Needed Instruments

A fault of some executives is that they will not provide the instruments and apparatus necessary to obtain these data. Rightly applied, these instruments and apparatus form an investment that is equal to and often better than any investment the company ordinarily makes. And this is not a sales talk. These things are fundamental in power plant economics.

Do not worry about the electric end of the plant. All essential instruments are provided here. The electrical industry started right by putting them in when the electrical machinery was installed, and by insisting that they were, of course, necessary. And everybody has accepted the practice without even thinking of questioning it. But look over the steam end and if means are not provided for getting the data called for above, then be assured that you cannot even make a start in cutting power costs. Fuel and water are the raw materials in power production.

There are many, many things that must be done before power costs can be cut after the plant has all the essential instruments. They involve a working knowledge of the suitability of fuels to grates and stokers and loads; the many problems, both chemical and mechanical, of combustion of fuels; heat conductivity; economical loading of boilers and prime movers; economical management of auxiliaries.

But chief of all in cost cutting, the engineers must know how to get fuel economy in boiler rooms. Concentrate on the boiler room. Most operating engineers are common sense fellows who know how to do their work better than they know how to express how it is done. Given the lead by the executive, they will cooperate as few other department personnel will.

Observations On Oil Shale Treatment Processes

By Kirby Thomas

Consulting Engineer, New York

THE treatment of oil shale to recover the oil and by-products is not a combination of retorting and oil refining processes. It is essentially an oil refining process from start to finish insofar as the oil products are concerned.

The retort in its relation to the oil shale process is a sort of concentration device, analogous to the various machines and arrangements resorted to in metal mining for the separation of the metallic ores from their associated gangue or waste. The hydrocarbon material in the oil shale is in physical not chemical, association with the inorganic materials. It constitutes from 10 to 40 per cent. of the shale by weight. It is somewhat similar to the inorganic minerals of commercial metallic ores, differing, as will be pointed out, in the unstable character of the chemical association of the hydrocarbon elements. The shale gangue is chemically inert and it is unchanged in any way by the temperature proposed for the retorting stage.

A loosening and expansion of the waste often result from the removal of the hydrocarbon material and some kinds of shale are sticky under processing. Fluxing or clinkering of the shale does not take place except at temperatures usually higher than needed even for the ammonia recovery step. Apparently no practical method can be devised to separate the hydrocarbon material from the inorganic constituents of the shale by gravity concentration, pressure, filtration, or by the new flotation methods, and liquation as with sulphur is not applicable. Separation by means of solvents, as in leaching of ores, has not yet been attempted commercially and is considered impracticable.

The most suitable, the most easily available, and probably the only practicable method of separating the hydrocarbon material is by application of heat to gasify or vaporize the hydrocarbons compounds and thus to effect the separation desired as the necessary preliminary step in the process. This method would be effective, simple of application and easy of control if the hydrocarbon material were made up of simple, definite and stable chemical combinations.

The hydrocarbon compounds of the shale, being in an arrested state as it were of natural chemical change, contain many poorly defined and unstable (unsaturated) molecules. As might be expected these molecules are more easily changed or destroyed by heat energy than are the molecules of natural crude oil, a more mature and settled product derived probably chiefly from shale oil by natural processes which are not unlike in effects the commercial treatments proposed for the oil shales. The hydrocarbon molecules in the shale differ greatly in character in the same deposit; and different deposits of shale present different hydrocarbon compounds and mixtures.

The hydrocarbon material of shale varies in the same deposit and from different deposits much more than the natural crude oils from different fields. The process of "fractionation," "cracking," etc., in the refining of the hydrocarbon material of shale is, for reasons above set forth, more difficult than the same procedure with crude oil. The application of the heat necessary to gasify (vaporize) the hydrocarbon material of shale to effect the separation from the waste, unavoidably will bring about molecular changes. Thus, one of the essential steps of refining, begins in the retorting stage of the shale processes.

Retorting is refining and the principles and methods of oil refining practice must be practically and effectively applied in the retort stage of shale treatment. It is not easy to treat the mixture of shale and hydrocarbon materials by the same methods and under the same condtions that are applicable to natural crude oils, because of the large bulk of the waste which affects heat transmission and control and which presents the mechanical difficulties of handling. There is further difficulty in the control of the heat applied to the differing hydrocarbon molecules physically intermingled in the shale.

If the heat is properly controlled and applied in the retort step and the resulting vapors taken off as a mixed vapor or preferably at stages defined by the molecular groups of practical importance in refining, then the further refining of the oil or oil vapors to produce commercial grades will not be difficult.

There are now sufficient data available relating to the mechanical and operating features of suitable retorts to permit a competent engineer and technologist to plan and construct a working commercial unit which will economically apply and control the heat, as it may be scheduled by the refining technologist after consideration of the character and condition of the hydrocarbon materials to be heated.

The mechanical equipment required and the technique of operation from the beginning to the end of the oil shale treatment are interlocking and overlapping, considered from the standpoint of either retorting or refining.

Manufacture and Properties of Writing Inks

By Frank F. Rupert

Industrial Fellow, Mellon Institute of Industrial Research, University of Pittsburgh

APPROXIMATELY one and a half million gallons of writing ink are produced annually, even in the present age of printing presses and typewriters. This figure, reduced to per capita consumption, amounts to two ounces for each individual per year. Though limited in quantity as compared with some of our other daily needs, writing ink is one of the most important.

FRANK F. RUPERT
Industrial Fellow, Mellon Institute of Industrial Research, University of Pittsburgh.

Ink is defined as "a colored liquid or viscous substance used in writing, drawing or printing." The term includes substances differing widely in chemical composition. The two most general classes of ink are printing inks, which are usually closely related to paints, and writing inks, which are always aqueous solutions or suspensions. The attention of this paper will be confined to writing inks, except to mention several kinds of ink which may be considered as intermediate between the two general classes.

Early History

In the early development of the use of written characters, a number of colored substances were undoubtedly used as inks. Most of these inks, as can be learned from a number of authorities, were of an ephemeral nature. One of the earliest inks, however, was composed of charcoal and glue, and the characters in which it was used were very permanent. One Egyptian specimen of writing made with such ink dates from 2500 B. C. The Chinese ascribe the invention of a similar ink to Tien-Tchen, at about 2700 B. C. For many centuries this remained the most permanent kind of ink, and the Chinese variety, usually known as India ink, marketed in the form of sticks, was used almost exclusively as a drawing ink until recently.

Next in order of permanency was sepia, the dried secretion of the cuttle-fish and similar marine animals inhabiting the Mediteranean. This secretion serves this animal as an "ink screen" when pursued, and the dried secretion, mixed with water, produced a very dark-colored liquid. Sepia is still used as a pigment; but the ink, like the carbon ink, is a suspension, not a solution, and it disintegrates too easily for present-day requirements.

Our word "ink" is derived from a variety of ink known to the Greeks and Romans as "encaustum." It was purple in color, and therefore considered appropriate for use in the documents of the late emperors. Whether it was a variety of the "Tyrian purple" dye we do not know. Among the modern languages, the Italian modifies the word to "inchiostro," the French shortens it to "encre," and the English abbreviates it still further to "ink."

Early Iron Tannate Inks

Juices of plants always have been used to some extent as inks, some with a fair degree of permanency. None of the unmordanted derivatives of these juices, however, would be satisfactory for modern requirements. It was known to the Romans that a mixture of copperas with the extracts from certain woods and barks produces a very permanent dark color on fabrics. The first account of an ink based on this principle is given by the monk Theophilus, in the eleventh century, A.D. Thornwood extract and copperas were the chief ingredients of this ink. Later, other bark extracts were found superior in the quantity and quality of tannin, as we now know it, until the best results were found to be secured through the use of excrescences such as nutgalls. From that time the use of "iron-gall" inks gradually displaced the carbon and other inks, until at the present time the great bulk of writing ink used is of this character. At first the ink was made only in homes and monasteries, usually according to recipes handed down from generation to generation; but early in the nineteenth century ink manufacture became an important commercial process.

The developments in the writing ink industry within the past fifty years have consisted in the invention and somewhat increasing production of certain varieties of ink which will be discussed after considering the chemistry of the iron tannate inks.

Chemistry of Iron Tannate Inks

The chemical phenomenon upon which the use of iron tannate ink is based is the formation of an insoluble dye by tannic acid and related compounds with ferric iron. Other metals—chromium, aluminum, nickel, cobalt and others—form similar compounds; but the peculiar efficacy of iron lies in the fact that no such compound is formed by iron in the ferrous condition, so that the ink may be made from a ferrous salt and applied without being materially oxidized, and the color is then developed on the fiber of the paper by oxidation.

Tannic acid is one of a number of derivatives of phenol, which produce deeply colored compounds with iron and other metals. Phenol and a number of other compounds containing one hydroxyl group give dark solutions which do not color paper. When two hydroxyls are present on the same benzene ring, the color is deeper and paper is colored, but the mark is not very permanent toward light or reagents. The maximum of permanency is attained when three hydroxyls are present on the same phenyl group, as in pyrogallol and gallic acid. Gallotannic acid, commonly known as tannic acid, has the constitution of a di-gallic acid, with a total of five hydroxyl groups. Its iron compound, though not so deeply colored as that of gallic acid, is fully as permanent.

Among the natural sources of tannins, there is much variation in the nature of their iron compounds. In general, they are classed as "iron-greening" and "iron-blueing" tannins, according to the color produced. The former are the most suited for tanning, while only the latter possess ink-making properties. There are several other points of distinction. While the chemistry of the tannins is not thoroughly understood, the reactions of the "iron-greening" tannins are in general agreement with those of the di-hydroxy compounds, and the best ink-making materials are those in which the tannin most nearly approaches true digallic acid. This substance is found in the highest proportion and purity in nutgalls, which are excrescences developed on the bark of twigs of certain species of oak, subsequent to the deposition of the eggs of the gall wasp. There are many varieties of these galls, but the best, used almost exclusively for ink-making, are known as Aleppo galls, occurring only in Asia Minor and Mesopotamia. They often contain as high as 65 per cent. of gallotannic acid.

Gallic acid inks are deeper in color than tannic acid inks, but the comparatively slight solubility of gallic acids sets a limit to the amount that can be used. The best ink, therefore, is one containing both tannic and gallic acids. Tannic acid is easily transformed into gallic acid by fermentation, and, long before the chemical nature of the nutgall extract was discovered, it was a common practice to allow the wet, powdered nutgalls to ferment to the proper degree before using them. At the present time, the gallic acid is often produced from the nutgall extract or added separately, but it is difficult to standardize the amount of gallic acid, and progressive manufacturers employ a mixture of the pure acids.

An ink made from ferrous sulfate and tannic and gallic acids alone has but little color; in fact, it is barely legible when first applied, and at least several hours are required for the writing to become plain. To render the writing easily visible immediately, in the earlier history of ink preparation, the ink or the constituents were allowed to become partially oxidized before using. By this process, however, a considerable amount of insoluble ferric tannate and gallate was developed in the ink. On application, this precipitate was attached merely mechanically to the paper and therefore easily removed. This situation was distinctly improved in the middle of the nineteenth century by the invention of the so-called "alizarine" inks, now know as blue-black inks, which contain a suitable blue dye, in sufficient quantity to give a preliminary color to the writing until the ferric tannate has time to develop. Consequently, it was no longer necessary to allow partial oxidation to take place; on the other hand it was hindered, especially by the addition of a mineral acid. Sulfuric acid, although sometimes used, was found unfit for this purpose, as it remained in concentrated form when the ink evaporated and consequently attacked the paper. Hydrochloric acid is generally employed on acconnt of its volatility.

Gum arabic was added to the earlier inks in order to keep the precipitated ferric tannate and gallate in suspension, and to impart a slight viscosity to the ink. Even after the development of the "alizarine" inks, it was considered an essential constituent. It was later found unnecessary by several investigators and its use has been to a large extent discontinued.

The development of the aniline dyes led to the replacement of indigo carmine, which was used at first, by some of the newer dyes. There are but few dyes, however, which have the necessary solubility in the presence of all the other ingredients of the ink. Only one class of closely related dyes has proved satisfactory. They have been variously named Bavarian blue, water blue and soluble blue. Only a small number of the dyes bearing these names are of use, and as a rule they are those which are of least value as textile dyes.

Standard Ink Formula

Much attention has been given to the question of the most suitable proportions in which the ingredients are used. In 1890, Schluttig and Neumann[1] proposed the following formula as a standard for governmental record work, as assuring the highest degree of permanency:

	Grams
Tannic acid	23.4
Gallic acid	7.7
Ferrous sulfate	30.0
Dilute hydrochloric acid, U. S. P. (10%)	25.0
Phenol	1.0
Suitable blue dye	2.2
Gum arabic	10.0
Water to make a volume of 1 liter at 15.6° C.	

This formula was adopted as a standard by the Prussian Government, and later by the United States Government. The gum arabic has been omitted in the most recent recommendations. It is not required that the inks actually used conform to this formula, but the desirable properties of such inks must equal or surpass those of the standard.

Commercial Inks

Analyses of blue-black inks on the market show that the essential ingredients are used in one-half or less of the amounts indicated in the given formula, while the dye, although depending on the character of the exact dye used, is usually present in a greater amount. Such inks, then, are naturally not so permanent as the Schluttig and Neumann standard. This circumstance has led to charges of dishonesty,[2] against modern ink manufacturers, in that they reduce the strength of the ink and replace the loss by the addition of aniline dyes, which are not permanent.

These charges, in the author's opinion, are unjustified. The high degree of permanency possessed by the standard ink or one of similar composition is offset by its high corrosiveness and poor keeping quality, and, consequently, inks of that strength have always proved unpopular when introduced to the public. The permanency of the best commercial inks is amply sufficient for ordinary purposes; they resist long-continued exposure to light and severe drenchings such as might occur in a fire. With further reference to the charge of dishonesty, it may be added that the aniline dye most commonly used is by far the most expensive ingredient of the ink, and so, although it is used in smaller quantities than the essential ingredients, its substitution for them, if it is to be regarded as a substitution, does not materially lower the cost of the ink. In cases where the highest degree of permanency is necessary, a special ink approximating the standard formula may be obtained on application to the manufacturers.

Requirements for Ink

This leads to a consideration of the question of what are the fundamental qualities which inks must possess in order to fulfill the requirements of the consumer. They may be grouped under four heads, viz., color, permanency, fluidity and non-corrosiveness. "Permanency" refers to the resistance of the ink after application toward light, water, weather and reagents.

[illegible]

while "stability" refers to the continued color, fluidity and freedom from sediment of the ink in the bottle. A dark and pleasing color is required of all inks; permanency is highly essential, except in some classes of correspondence; stability is especially necessary in fountain-pen inks, while non-corrosiveness is highly desirable whenever steel pens are used. The standards for the various qualities naturally differ according to the use to which the ink is to be put; but any practical method of analysis of ink must take account of the fundamental requirements and, in general, give them approximately equal weight. The task of the ink manufacturer is to produce inks in which these qualities are properly balanced.

There is no other class of ink which threatens to displace the blue-black in general popularity, but there are several classes which have some degree of favor, at least for special uses, and these will now be discussed briefly, with special reference to the fundamental qualities enumerated.

Chrome-Logwood Inks

Hematoxylin is a phenolic derivative, with only one true phenyl group, and containing only two of its three hydroxyls attached to that group, but it resembles tannin in forming stable dark-colored compounds with metals. The source of this substance is the logwood tree, found almost exclusively in Campeche and the vicinity. Logwood inks with various metallic bases have been prepared, but the most satisfactory contain chromium, used generally in the form of potassium chromate or dichromate. Logwood extract and its metallic compounds are not very soluble in pure water, but are rendered soluble by the addition of either acid or alkali. Most inks labeled "jet-black," which have a blue to violet color in the bottle, are acid crome-logwood inks of this nature. They are said to be less permanent than iron tannate inks, but over short periods of time they compare very well with those inks. The logwood inks have the advantage that no time is required for the development of the color or resistance to water. The chief defect of these inks is lack of stability, i. e., a sediment forms within a short time, especially when the ink is exposed to the air. Alkaline chrome-logwood inks are similar in their general properties, and do not give rise to a sediment; on the other hand, they easily lose their color in the bottle, finally becoming pale brown.

Aniline Dye Inks

Solutions of various aniline dyes have come into vogue as inks within recent years. Practically all colored inks, especially green, yellow and videt, and most red and blue inks, belong to this class. For social correspondence and for purposes where permanency is not essential, these inks are highly desirable on account of their non-corrosiveness and stability. On the other hand, it must be remembered that they are as a rule easily removed by water. One exception to the rule comprises solutions of nigrosine, often labeled "school inks," which have a fair degree of permanency, intermediate between that of the other aniline dye solutions and that of the iron tannate and chrome-logwood inks.

Carbon Inks

Inks of the ancient Chinese and Egyptian type have by no means completely disappeared from use. "India" ink was in large demand until recently for drawing, but now it has been largely displaced by a liquid ink in which the carbon is reserved in a fairly stable suspension by the addition of a peptizing agent and a protective colloid. A more dilute suspension than the drawing ink is used in writing. It has a slightly brownish black color. It is very easily removed by a blotter when freshly applied, but when once "set" it is practically as permanent as the paper. The carbon tends to settle on long standing.

Prussian Blue Inks

There are on the market a number of inks, sometimes advertised as safety inks, of which the principal ingredient is soluble Prussian blue. Though highly resistant to acids and fairly so to water, their chief defect is easy removal by alkalies. The essential properties of the various classes of ink described will be seen at a glance in the following summary:

Ink	*Color*	*Permanency*	*Stability*	*Corrosiveness*
Iron tannate	Blue, later blue-black	Very good	Good	Moderate
Acid logwood	Violet	Good	Poor	Slight
Alkaline logwood	Blue-black	Good	Poor	None
Carbon	Brown-black	Very good	Fair	None
Prussian blue	Greenish-blue	Fair	Good	None

The description applies, of course, to the best ink of the class under consideration.

Miscellaneous Inks

There remain to be considered several varieties of ink for special purposes. Copying ink is usually an iron tannate or logwood ink, usually more concentrated than writing inks, with glycerin or similar substances added. Rubber-stamp inks are usually solutions of dyes in glycerin. Typewriter inks are somewhat analagous to the rubber-stamping inks. Fountain-pen inks usually differ in only two respects from the corresponding blue-black or colored inks not so labeled; the bottle and label, and the price. Manufacturers and dealers declare that the public demands the fountain-pen inks at higher prices and cannot be convinced that the inks are the same. It may be said on behalf of the public that the demand for fountain-pen inks is the result of the dissatisfaction with the ordinary inks and the hope for something better.

Examination of Ink

The examination of an ink and the comparison of inks submitted for a given purpose is the task of the chemist, although tests in which the qualities of the ink are determined directly are more useful than merely analytical tests. All published methods of testing follow to a large extent those of Schluttig and Neumann. In the actual testing there is not much improvement to be suggested in the methods now employed by the Government bureaus, but in the co-ordination of the tests there should be a fuller consideration of the needs of the ordinary consumer of ink, and in the author's opinion the four fundamental qualities—color, permanency, stability and non-corrosiveness—should be given more nearly an equal rating. The author proposes to discuss this question at some length in a future paper.

Problems of Ink Manufacture

The principal problem confronting the modern ink manufacturer is to produce an ink in which the qualities of color, permanency, stability and non-corrosiveness shall be blended in the best possible way, profitably at a low price. The maximum in each quality appears to be unattainable except at the expense of the other qualities, so the question is, what to sacrifice and what to emphasize.

The ideal ink would be one in which carbon, or an equally stable substance, is in solution, not in suspension, in a cheap, non-corrosive and stable medium; but until such a solvent is discovered, the research problems of ink manufacturers must continue along the line indicated. The choice of dye still remains difficult, as a suitable dye can be obtained from a very limited number of manufacturers, and the quality, even under the best conditions, is not always uniform. In addition to constant vigilance over raw materials and production methods, scientific research must seek all possible improvements, great or small, leading to the ultimate goal of the perfect ink.[1]

De-Inking Printed Paper with Bentonite

The properties of bentonite, which was described by Raymond B. Ladoo, U. S. Bureau of Mines, in CHEMICAL AGE, November, 1921, admit of application for many industrial purposes, whose commercial practicability awaits only experimentation. This has been pursued, e. g., in the de-inking of printed paper with such successful results as to warrant the preemption of its use in this field by Patent No. 1,421,195, issued June 27, 1922, to the Paper De-inking Co., Chicago, Ills.

Bentonite, in a more recent description by Sidney D. Wells, engineer in forest products, Forest Products Laboratory, Madison, Wisc., is defined by the U. S. Geological Survey as a transported, stratified, volcanic ash that has been altered shortly after deposition. It is very fine grained and has the property of swelling in contact with water to several times its original volume into a jelly-like mass which on further dilution forms colloidal solutions which will remain in suspension indefinitely in mixtures as dilute as one part of bentonite to fifty parts of water. It possesses, however, the variability in desirable properties peculiar to all natural products, the most highly colloidal in character being found in Wyoming, although it occurs in various parts of the West.

Bentonite is to be distinguished from clays such as fuller's earth and kaolin, in that with neither of these can a permanent colloidal solution be obtained, since the particles of the clay rapidly settle out from the water, whereas bentonite forms a substantially permanent colloidal solution, probably due not only to the fact that it is a different substance but also to its different physical characteristics, the particles of bentonite being extremely small, 70 per cent., according to Dr. H. W. Wiley, being less than .0015 millimeters in diameter.

In de-inking printed paper, especially newspaper, it is comparatively easy to loosen the carbon black by decomposing the varnish of printing ink by means of soda ash or caustic soda, using as little as 40 lbs. of soda ash per ton of paper at temperatures as low as 120° F. It has been difficult to wash out the carbon black, after liberation, inasmuch as the fibres of the paper stock serve as an effective filter to enmesh the particles of carbon. Heretofore, means of washing commonly used would not permit its complete removal without excessive losses of pulp and such expenditure of time, power and water as was prohibitive. The problem is entirely different from the removal of soluble impurities such as cooking liquor or bleach residues; the successful methods for handling these impurities will not answer the purpose. With bentonite, however, we have a substance that will pass through ordinary filters and with its enormous surface, on account of the extreme fineness of its particles, will carry the carbon black along with it.

The possibilities of a process for the recovery of old newspaper stock are apparent to anyone familiar with the paper industry. When the price paid for old paper stimulated collection it is reported that about 25,000 tons per month were collected in Chicago, of which 40 per cent was news. During the same period Cleveland is reported to have handled approximately 350 tons per day of which 1[illegible]0 tons were news. In our large metropolitan centers probably 2,500 tons per day were collected, which would furnish a very considerable portion of our daily consumption of approximately 7,000 tons of newsprint. Furthermore, the source is at the place of consumption and the saving in freight is a very important item. The color requirements of the publishers at the present time are very severe and any process that does not thoroughly remove the ink cannot be successful.

A National Organization of Dyers and Bleachers

Representatives of the dyeing and bleaching industry in Pennsylvania, New York, Massachusetts and Rhode Island, met at Hotel Biltmore, New York City, on June 21, 1922, to discuss trade conditions and to consider the formation of a national organization. It was the unanimous opinion of the meeting that such organization was necessary and should be formed. An organization committee was appointed which in its personnel represents the various branches and districts of the industry. It comprises: William J. Wall, Nicetown Dyeing Works, Philadelphia, Pa., chairman; Gerald A. Cooper, Providence, R. I.; J. H. Felton, Valkone Dyeing & Finishing Works, Philadelphia, Pa.; W. C. Foulds, General Processing Co., Philadelphia, Pa.; Louis Heymann, Manhattan Yarn Dyeing & Bleaching Works, Inc., Brooklyn, N. Y.; George M. Orr, Worcester Bleach & Dye Works, Worcester, Mass.; H. E. Quereau, Neversink Dyeing Co., Reading, Pa.; D. F. Waters, Germantown Dye Works, Germantown, Pa., and Herbert S. Blake, secretary, Master Dyers' Exchange of New England.

Government Cooperation with Chemical Industry

Carl R. DeLong, chief, chemical division, Bureau of Foreign and Domestic Commerce, announces that his division is desirous of aiding American chemical manufacturers by placing at their disposal accurate and detailed information on the markets in foreign countries for their products. The following branches of industry will be handled by this new division:

Chemicals, general organic and inorganic.
Dyes and coal tar chemicals.
Pigments, paints and varnishes.
Fertilizers and fertilizer materials.
Botanical drugs, pharmaceutical and medicinal preparations.
Essential oils, perfumery, cosmetics and toilet preparations.
Explosives and fireworks.

Mr. DeLong states that the bureau constantly is receiving inquiries in regard to the introduction of American products into various foreign countries. The Chemical Division can serve as a means of bringing these opportunities promptly to the attention of domestic concerns interested in the specific commodities.

One of the first steps in organizing the division will be the compilation of a list of domestic firms interested in the development of foreign trade. This list, known as the Exporters' Index, will serve as the basis of dissemination of information on trade opportunities and conditions in foreign markets.

The division also expects to organize advisory committees for each of the various branches of the chemical industry to co-operate with the Department of Commerce. Where there is a trade association already existing in the industry, contact will likely come through such association. Assurances have already been received from certain of the trade associations in the chemical industry of their willingness to co-operate with the Chemical Division in furthering foreign trade. The division is desirous at all times of receiving suggestions from representatives in the industry of methods by which it can be of aid to domestic manufacturers.

---

[1] For text reference for fuller information on ink from the scientific standpoint see "Inks, Their Composition and Manufacture," by Mitchell and Hepworth; [illegible] "Forty Centuries of Ink" [illegible] methods are covered in Circular No. [illegible] U. S. Bureau of Standards.

Centralized Softening of Public Water Supplies for Industrial and Potable Purposes

By S. C. Hadden
Editor, Municipal and County Engineering

THE subject of centralized softening of public water supplies is not new, as central softening plants have been in successful operation in a few American cities for several years. The process, however, is capable of great extension, as there are a great many communities now using hard water where the installation of a central softening plant would be of great advantage to both the domestic and industrial consumers of the water.*

Most observers of developments in the public water-supply field agree that the time has arrived when water utilities should no longer be satisfied with their product, however palatable and pure it may be, if it is too hard, as drawn from the tap, for agreeable use in the home and for economic use in industry. All agree that a hard water is an expensive and troublesome water to use.

Where the need for water softening is indicated it will usually be found more economical to soften the entire supply at a central plant before it is distributed than in the home and factory after it is distributed. By softening in the home we do not refer especially to the use of household water softening plants, but to the use of softening powders, hard water soaps, etc.

What is Soft Water?

The terms "hard" and "soft," as applied to water, are, of course, relative. A water that would be acceptable as "soft" in some sections of the country would be rated as intolerably "hard" in other sections of the country. Most water works engineers accept substantially the following classification of water as to hardness:

Very soft	30 to 50 parts per million
Moderate	50 to 100 " " "
Hard	100 to 300 " " "
Very hard	Above 300 " " "

Professor William P. Mason in his "Examination of Water," has this to say of "hard" and "soft" waters:

> "The rating of water as 'hard' or 'soft' is very often a matter of local preference. Thus the writer has encountered cases of complaint from people using a water of as low a hardness as 30 parts per million, and has heard described as of 'good quality for boiler and laundry uses' a water which ran 66 in hardness. After wide inquiry among industrial water-users the author has concluded to classify waters as 'soft' which do not exceed 50 in hardness; to call those 'hard' which exceed 100, and to consider the intermediate values as a sort of neutral ground where local conditions and preferences shall govern."

Opinions of Water Works Engineers

Believing that the next great development in the water works art is destined to be in the centralized softening of public water supplies, the author invited several prominent water works engineers to participate in symposia† on the subject. The opinions expressed by these authorities were so strongly in favor of centralized softening that one of our correspondents suggested that those taking part in the symposia must have been "hand picked." They were so selected because of their very high standing in the water works engineering profession and not because of their views on water softening, for the writer did not know the opinions of several of these men until their discussions were received for publication.

It is very significant, therefore, that they all agree that in the present state of the art of water-softening it is economically feasible to soften an entire public water-supply at a central point before it is distributed to the consumers. In a very great many cases they agree that it is cheaper for the average water-taker to pay more for a softened water than to soften it on his own premises; this applies to the domestic as well as to the industrial consumer. Most of these authorities specifically recorded their approval of the lime-and-soda-ash process,* as up to the present time this process is practically the only one available for the softening of an entire municipal supply. It is admitted that the process requires expert supervision if after-deposits in water mains are to be avoided; but even where this precaution is taken, the process is low in cost and this, of course, commends it to the public and to the engineering profession.

On the subject of after-deposits in water mains, Mr. E. B. Black, consulting engineer, Kansas City, Mo., said:

> "In times past the difficulties experienced from deposits or sediments in mains and service pipes have come about because of lack of adequate filtration for removal of sludge following the softening process. The number of plants following softening by filtration, and successfully eliminating this difficulty, show that there is no excuse for its occurrence if the filter plant is properly designed. My own firm has successfully eliminated this trouble in several municipal plants, and other engineers have, of course, had the same gratifying experience."

The subject of after-deposits is here introduced only because it frequently comes up in localities where water-softening is suggested. The trouble experienced with these after-deposits in former times is now given as an excuse for postponing the installation of central softening plants. It is very important to note, therefore, that in the opinion of expert engineers this objection is no longer valid.

Advantages of Soft Water

Soft water has many advantages and, of course, hard water has corresponding disadvantages. It is interesting to quote further, from the opinions expressed by expert engineers on this subject in the symposia already mentioned, as follows:

George A. Johnson, consulting engineer, New York City.—"Why municipalities will continue to force their citizens to waste soap to soften hard water; money to support the troublesome rain water cistern supply; abnormal amounts of coal to raise steam in badly incrusted boilers; coal waste again to provide the increased pressures required to force the municipal supply through hardness-incrusted mains, etc., is hard to explain. The average city of this country provides a satisfactory water supply as regards hygienic purity, but the same city has failed to date to take proper account of the hardness of the water. It is no extravagance of statement to say that unquestionably scores of cities in America would profit in a really big way by adopting water softening for their municipal supplies. It is certain that in numerous places the collective citizenry and industries are spending each year many times the cost of centralized water softening, and, not only that, they are doing an imperfect job of it in most instances, and all around a far less satisfactory job than could be effected in centralized municipal water-softening plants."

---

*A paper presented at the annual meeting of the National Lime Association, June 14, 1922, at Cleveland, Ohio.

†Published in *Municipal and County Engineering*, March-April, 1922.

*CHEMICAL AGE, Jan. 1922, "Treatment of Water for Steam Making," by Julian S. [illegible], Consulting Chemical Engineer.

Charles B. Burdick, consulting engineer, Chicago.—"In many localities the mineral character of the public water supply determines whether the development of the city shall or shall not be industrial. There are several mid-western cities whose growth has been so retarded that they have been passed by more fortunate neighbors, apparently due to an excessively hard public water supply, such that it is unprofitable for use by manufacturers."

Samuel A. Greeley, consulting engineer, Chicago.—"Hard waters are objectionable in many ways. For domestic use they require larger quantities of soap; they are unsatisfactory for washing, have an annoying effect on the skin and increase the plumbing bill. For boiler use they cause trouble by forming scale, cause interruption in service, shorten the life of boilers and fire boxes and increase the fuel bill. In certain industrial processes hard waters are considerably less satisfactory than soft waters. It is generally easy to make a computation on paper proving that water softening pays. It is frequently, however, found difficult to finance the first cost even at the assured annual saving."

As the increase in population of cities tends to become slower and more settled the competition for new industrial establishments increases. It is believed that a study of city growth would indicate a general tendency for communities with soft waters to grow faster than communities with hard waters. Thus the installation of water-softening plants will tend to community development. Further as soft waters become more common, housekeepers learn of their advantages in moving from one city to another, and thus the demand for soft water increases. It appears, therefore, that water softening is on a satisfactory basis for design, construction and operation.

A Great Opportunity

In extending the practice of softening public water supplies there is at once a great opportunity for public service and for business extension. We have shown that expert engineers feel that cities should move forward in this matter. Of course some installations are being made and will be made in the near future. For example, it is proposed to soften the water supply of Minneapolis, drawn from the Mississippi River, and the supply for Kansas City, Mo., drawn from the Missouri River. Other smaller installations are in prospect. It is a fact, however, that in many localities where it would be well to soften water the subject has not been agitated at all.

It is my opinion that an intensive educational campaign, utilizing all the effective agencies that can be brought into play, would expedite greatly the installation of central softening plants with profit to the public and to the industries producing the requisite softening agents. Of course it will require money to carry on such an educational campaign, and it is to be hoped that means will be provided so that this work can be carried on. This is a favorable time to undertake the work, for water utilities are in better condition now than they have been in recent years. They are ready to take on new ideas and to do new work. Construction costs are lower now than they were during the period of inflation, and are lower than they are likely to be in the near future, since much construction work is being done at or below cost in order to hold construction crews together. The time seems very opportune, therefore, for pressing vigorously this educational campaign.

It is suggested that in carrying on such a campaign it would be well to bear in mind that, while it is desirable to reach the individual citizen, this is necessarily a very expensive process. Much can be done by convincing political and industrial leaders in a community that it would be to the advantage of the community to have a supply of softened water. Special efforts, therefore, should be made to arouse the interest of technical professional men, particularly chemists, and public officials in this question and equally great efforts should be made to interest men who are engaged in manufacturing in which a public supply of soft water would result in substantial annual savings to the water-user.

Lime Requirements for Water Softening

A complete survey of the need for lime in water softening has not been made for the entire country, but data* are available for 338 municipalities in the State of Illinois which indicate that the amount of lime needed for softening the waters in these 338 cities would be 38,763 tons of lime. This consumption is based on an assumed average daily per capitum consumption of water of 80 gallons, or 99,743,920 gallons per day for the 338 cities which, at the rate already indicated, would give an annual demand for lime amounting to 38,763 tons.

Using the same fundamental figures, we have calculated a potential tonnage for the entire State of Illinois amounting to 121,328 tons per year. This figure is obtained by assuming that 60 per cent. of the population of Illinois is in urban communities where water softening is desirable and practicable, and by assuming that the amount of lime required for treating all of the water in these urban communities would be the same as in the 338 Illinois cities already mentioned. More specifically, 60 per cent. of 6,500,000 is 3,900,000. The ratio of 1,246,799 to 3,900,000 is 3.13. Now, 3.13 times 38,763 would give a total demand of 121,328 tons of lime per year which, we believe, is a conservative estimate for the single State of Illinois.

For these figures, pertaining to the State of Illinois, a rough figure on the requirements of the entire country may be computed. Again assuming that 60 per cent. of the entire population of the country resides in urban communities in units large enough for public water supply systems, we have a figure of 66,000,000 as representing the population that could be served by water treatment plants of one kind or another. This would represent a need of 2,062,576 tons of lime per year for water softening in this country, assuming that the requirements for the treatment of the waters in the State of Illinois represent a fair average for the entire country. It is true, however, that the hardness of Illinois waters is somewhat greater than the average for the entire country. Surely it is conservative to assume that only one-half as much lime would be used on the average for the entire country as for the State of Illinois. By this assumption we arrive at the figure of 1,031,288 is being a conservative estimate of the annual tonnage of lime required in water-softening for the entire country.

Contrast this figure with the 30,000 tons now being used per year for this purpose, and it is at once evident that the market for lime in the water-softening field is only about 3 per cent. developed at this time. The remaining 97 per cent. is surely worth going after.

---

*Bulletin No. 16 of the Illinois State Water Survey

Arthur A. Hammerschlag, president Carnegie Institute of Technology, Pittsburgh, since 1903, has resigned and will become consulting engineer and adviser to corporations, with offices in Pittsburgh and New York.

Carbon Tetrachloride in Fire Extinguishers

RECENTLY at a New York section meeting of the American Chemical Society was emphasized the responsibility of chemical journals to protect the investing public from the purchase of stock or securities of shady chemical enterprises. The reverberation of senseless political condemnation of standard fire extinguishing equipment in the editorial of a technical publication which confirmed the politicians' baseless charge, to the embarrassment of a reputable manufacturer, indicates that the people should be protected as well from the careless consideration of facts by those agencies to which they rightly turn for technical information.

The Transit Commission of the State of New York in its report July 21, 1922, of its investigation of the electric fire on July 6 on an express train in the Lexington Avenue (New York) subway, confirms CHEMICAL AGE in its observations in the July number, page 324, of the causes of the disaster and of its consideration of the baseless condemnation of a long recognized standard fire extinguisher. Excerpts from the Transit Commission's report follow.

Physiological Effects of the Electric Fire

The experts of the U. S. Bureau of Mines as well as the Transit Commission's surgeon have concluded exhaustive investigations into this important phase of the accident. The results of these investigations are summed up in their respective reports as follows:

U. S. Bureau of Mines. 1. That there apparently were no really serious cases resulting from the effects of possible toxic gases;

2. That the symptoms given in the hospital records can all be accounted for by the known effects of gases resulting from the burning of insulating materials, rubber, varnish and paint;

3. That the symptoms given are not characteristic of phosgene or carbon tetrachloride poisoning.

Physician of Transit Commission. Nine members of the crew of the train on which the accident occurred were interviewed, all of whom remained in the tunnel until all of the passengers had left the tunnel. Seven of these men had been actively engaged in fighting the fire. Of these seven men, four felt no ill effects whatever and remained with the train until it returned to the yard; one was slightly affected and was revived by taking a glass of water, and two were taken to the hospital. Of the two taken to the hospital, one remained five minutes, and the other 24 hours. None of the train crew showed any symptoms of poisoning by phosgene gas.

In analyzing the bedside histories of all the cases admitted to the hospitals, the symptoms were those that would be found due to a certain extent to the inhalation of smoke and the rapid climbing of stairways seventy feet in height to reach the street surface from the train. After a close study of all the hospital charts, no symptoms of phosgene poisoning were found.

The Fire Extinguisher

The fire extinguihser used both to break the electric arc and to extinguish the resulting fire in the insulation was of the carbon tetrachloride type furnished by the Pyrene Mfg. Co. in its containers and known as Pyrene. Seven extinguishers were used altogether on the fire. One extinguisher is carried regularly in each subway car. One extinguisher taken from the train in question and one from the Interboro storage were accurately tested in the Transit Commission's laboratories. The tests show that these samples were free from deleterious ingredients often accompanying carbon tetrachloride and were well within all the requirements of the specifications of the Underwriters' Laboratories' standard for extinguishing liquids for hand fire extinguishers.

George L. Lucas, Chief of the Materials Inspection Division, Transit Commission, assisted by experts from the Bureau of Mines, has conducted a detailed investigation into the use of this fire extinguisher in subways. He reports that carbon tetrachloride is a standard fire extinguisher in general use and is approved by the National Board of Fire Underwriters. It is particularly adapted for fires produced by short circuits in electrical equipment and apparatus, because it is a non-conductor of electric current and when properly applied in sufficient quantity and steadily will extinguish ordinary electric arcs. The use of carbon tetrachloride extinguishers is standard for small fires such as occurred in this train.

Having explained in detail the action of carbon tetrachloride when used to extinguish electric fires, Mr. Lucas states that if it be applied to red hot metal and oxygen be present at the same time, phosgene gas may be found which is poisonous in proper concentration; also chlorine gas, which is irritating to the respiratory organs, and when concentrated will cause asphyxiation. The report further explains how the conditions for forming phosgene in appreciable quantity were absent; and to only a slight extent, chlorine; and concludes that the vapors of the carbon tetrachloride and the chlorine gas that may have been formed contributed but little to the discomfort which was due mainly to smoke. The smoke fumes and vapors were due to the burning of insulation in the panel box, the rubber cushion on the vestibule door jamb, paint and varnish on the car walls and panel-box door, volatilized metals and carbon tetrachloride. The quantity of materials burned was 6.75 lbs. of organic matter of which 3.62 lbs. was rubber; also paint and varnish on 140 sq. ft. of car-body surface.

The report then analyzes the physical conditions at the fire, calling attention to the fact that the side door of the car was open at the scene of the fire; that all car doors, windows and ventilators also were open. The smoke and fumes generated by the burning of the above materials were acrid, pungent and irritating, dense, dark and of considerable volume. The duration of the intense burning of the fire was the duration of the short circuit, which was approximately four minutes. Immediately the power was turned off the fire was easily and quickly extinguished.

The smoke and fumes given off, including those from the carbon tetrachloride, were most dense and thick at the fire, yet members of the train crew stayed within a few feet of the fire throughout its duration and suffered no ill effects. It has been stated that carbon tetrachloride should not be used in such a situation, the claim being that the space was close and confined. This statement is made in misinterpreting the report of a test by the U. S. Bureau of Mines. The conditions within a subway car in a tunnel in no wise can be considered "a close, confined space" in the sense meant in the above mentioned report.

The Transit Commission's report concludes with the following statements:

1. Smoke and fumes generated by the fire were principally from burning insulation, paint and other organic matter.
2. The vapors and fumes from the carbon tetrachloride were so diluted due to the ventilation or draughts about the fire as to be negligible.
3. There is no evidence that poisonous gas was generated through the application of carbon tetrachloride.
4. A thorough search for a suitable substitute for carbon tetrachloride as a fire extinguisher in similar circumstances has yet disclosed none as good or better.
5. The use of sand or powder as fire extinguishers is impracticable, as all the electric equipment is either hung on a vertical wall, underneath the car floor, or from the ceiling. While they might break an arc they would not extinguish a fire in such locations.
6. The passengers affected by the smoke showed no signs of poisoning other than that from smoke from ordinary fires.

At the request of the Transit Commission the Bureau of Mines is conducting extended experiments with the use of tetrachloride as an extinguisher for electric fires under conditions such as are found in our subway service. These experiments and further investigations which will be made by the Commission's staff into the use of other materials for extinguishers will require considerable time. In the meantime the Transit Commission's study of the results of the use of Pyrene in this instance conclusively show that its use was in no way dangerous or even discommoding.

The continued efficient operation of the subways is essential to the life of the City, and this efficient operation requires the use of some immediately available fire extinguisher in case of electric short circuits which are always possible of recurrence. Tetrachloride is the best known and most universally accepted extinguisher for this purpose. Nothing has been discovered by the closest investigation to justify ordering its discontinuance. The General Manager of the Interboro System has ordered his employees not to use the Pyrene extinguisher on electric arcs. Until a better substitute is found it is believed that failure to use the extinguishers is likely to result in more damage and inconvenience to the public through increased smoke and delay than could possibly result from the use of the extinguishers. The Transit Commission therefore recommends the Interboro System be directed to resume the use of the tetrachloride extinguisher in case of electric short circuits as it has been heretofore used.

General Lincoln C. Andrews

The condemnation of the product of the Pyrene Mfg. Co. by Mayor Hylan and his political confreres, whose report characterized its use as "criminal" and demanded its elimination, was met by the report of the Transit Commission as above set forth, whereupon the Mayor demanded to know the identity of its administrative head who should stoop to *lese majeste*.

The Transit Commission was created by the State of New York in 1921, for the purpose of taking over the rapid transit construction and administration functions exercised by a previous commission, and the regulation of elevated, subway and surface lines, and stage and omnibus lines as exercised by still another earlier commission. The Commission is also charged with the duty of making a valuation of the properties of the rapid transit and trolley lines in New York, with a view to their being taken over by the City for operation by private companies under a plan of reorganization and readjustment which the Commission is directed to formulate.

The Transit Commission, shortly after assuming office, on April 25, 1921, established as one of its principal departments the Executive Office, and placed in charge of the department General Lincoln C. Andrews as chief executive officer. Among the functions and duties embraced within the scope of the office are general supervision over the technical departments and bureaus of the Commission, and also the general direction of the work of all employees and the staff. The functions may be classified in two major divisions, viz.: The Executive and the Administrative. Within the executive division are included the Engineering Department, the Bureau of Equipment and Operation, the Bureau of Valuations, the Bureau of Statistics and the Complaint Bureau. Within the Administrative division are Bureaus dealing with the auditing of the Commission's payrolls and pensions, printing, purchasing, supplies and storage, office maintenance and personnel. The Commission now has 873 employees.

General Andrews is a Cornell man and West Point graduate (1893) who retired from active military service Sept. 30, 1918, with a long and creditable experience in the Philippines, in the United States and in France during the World War, which now is available to the people in the solution of the transportation problems of New York City.

American Sugar Industry

In the decade of 1909-1919 the number of plants producing sugar from the beet increased from 58 to 85 with corresponding increase in the consumption of beets from 3,965,356 tons to 5,648,552 tons. Sugar produced increased from 501,682 short tons in 1909 to 721,909 short tons in 1919, valued respectively at $45,937,629 and $158,099,673. The states, with number of plants and percentage distribution of production, in order of statistical prominence, are as follows: Michigan, 16, 17.7 per cent; California, 10, 17.7 per cent; Utah, 16, 13.8 per cent; Ohio, 5, 4.9 per cent; Wisconsin, 4, 2.2 per cent; all other states, 34, 43.8 per cent. Colorado is the leading state in the manufacture of beet sugar, but on account of the disclosure of individual corporate operations the census returns do not show its activities separately; similarly with Nebraska, which ranks fifth between Utah and Ohio.

In the production of cane sugar close corporate control, particularly in refining, compels the combination of statistical information relating to cane sugar production and cane sugar refining in order to prevent the disclosure of individual enterprise. Refineries increased from 1909 to 1919 from 19 to 20, which, of course, does not include the new Baltimore refinery of the American Sugar Refining Company, which recently has gone into operation. The number of establishments producing cane sugar decreased from 214 to 202. In 1919, 60 establishments, or 27 per cent of the total number for the two industries, employed less than six wage-earners each, while only 0.4 per cent of the total average number of wage-earners were employed therein; on the other hand 15 establishments employed 67 per cent of the total average number of wage-earners, indicating the predominance of the small plant and the concentration of manufacturing operations in a few large establishments.

New York leads in sugar refining, followed by Pennsylvania, Louisiana, and California, while Louisiana is the leading state in the cane-sugar industry, which is distributed throughout the territory which is the same as that characterized as the "cotton belt." In 1919, 3,333,131 short tons of refined sugar were produced, valued at $713,767,395, while in cane sugar, production in the decade fell from 326,858 short tons to [illegible] indicating the volume of imported raw sugar upon which the refining industry depends.

Oil Shales of Kentucky

In the Publicity of Western Oil Shales as a Potential Source of Hydrocarbon Fuel Have Been Overlooked the Superior Commercial Possibilities of Deposits Near at Hand.

By C. A. Crouse
Professor of Metallurgy, University of Kentucky

AT the annual meeting of the American Mining Congress in Chicago last October the prediction was made that, barring the unexpected opening up of some large new field by January first next, the domestic consumption of crude oil would equal the domestic production plus the imports from Mexico. This is an extremely serious situation which is confronting us and it behooves those of us who are doing research work looking toward the prevention of this crisis to bestir ourselves so that when our pools of crude petroleum begin to diminish we may be ready to step into the breach.*

Typical Kentucky Shale Hill. These hills are 75-100 ft. in height, often joined by ridges, both hills and ridges being composed entirely of shale. Here is seen the usual flat topography adjacent to the hills, well adapted as a plant site.

Shale Exposure in Road Quarry. Here is shown the usual light over-burden and sparse vegetation.

Many minds are working on this problem from many different angles. It is not only a gasoline substitute that we need but actual crude oil; for, though we may be able to drive our automobiles with alcohol, or kerosene or what not, still, not a piece of machinery anywhere in the world can turn without lubricants and lubricants in sufficient amount can be obtained only from crude oil. Fortunately for the industrial life of the United States, we have, widely distributed, a vast, undeveloped and untouched reservoir of crude oil which has been lying dormant for millions of years waiting till the time was ripe and the ingenuity of man should fashion a key to unlock the treasure house.

Vast deposits of shale, differing somewhat in composition, but all falling under the general head of oil shales, occur in Colorado, Utah, Wyoming, California, Texas and other Western States. In the East, more immense deposits are found in Ohio, Indiana and notably in Kentucky, and it is these Kentucky deposits particularly that I wish to describe.

Kentucky Oil Shales

The whole of the State of Kentucky, with the exception of the Blue Grass region, where it is eroded away, is underlain with oil shale of varying thickness and at varying depths. But it is not all buried. Forming a frame for the Blue Grass region and extending from around Vanceburg in Lewis County on the north to near Louisville on the west is the famous knob country of Kentucky. Here the topography is broken up into low knobs and hills, seldom more than a few hundred feet high, joined by ridges and plateaus and interspersed with ravines and draws. This is a country practically useless from an agricultural standpoint and hitherto good for nothing but the concealment of moonshine stills. Nevertheless it represents one of the greatest, if not the greatest, of Kentucky's undeveloped resources, for it is the shale country. Here the shale comes to the surface and is covered by little or no overburden, its thickness varying from practically nothing up to from a hundred and fifty to two hundred feet. It is estimated that in this area there are 90,000,000,000 tons of shale which are amenable to steam shovel or quarry methods of mining, which means that the mining cost per ton will be from a third to a fourth that of coal.

Just what does this figure mean? It means that Kentucky alone can supply the whole United States with oil for years to come. Figuring conservatively this shale holds, locked up within itself, 40,000,000,000 barrels of crude oil, more than ever has been or ever will be produced in the United States from natural sources. But it is locked up and that is the crux of the whole situation. How shall it be released on a commercial scale and turned to industrial uses?

Oil shale does not contain, or at most contains but little, oil as such, but it does contain a substance which for want of a better name has been called Kerogen. If the shale is heated in the absence of air this kerogen is driven off in the form of hydrocarbon vapors some of which are condensable and some noncondensable. The former form crude oil and the latter a valuable fuel gas. This distillation can be made by anyone in the laboratory using very simple apparatus but it must be done commercially and that right soon.

---

*A paper presented at the ninth annual meeting of the Kentucky Academy of Science, May 20, 1922

Development of a Retort

For the past three years the writer has been conducting a research, as time allowed, in the mining laboratory at the University of Kentucky, the latter two and a half years in collaboration with E. E. Hedges of New York, looking to the development of a retort which would extract the oil from shale commercially. We have advanced slowly from a small intermittent machine till we now have in operation a retort that, running continuously, will handle three or four tons of shale a day and is, in my opinion, feasible commercially.

From the chemical standpoint the problem scarcely has been touched, nor do I think that the technical school laboratory is the place to attempt it, but rather in a fully equipped research laboratory in connection with a commercial plant. These things we know, however. That the heat must be applied gradually to crushed shale up to a maximum of around 920° F; that the gases must be withdrawn as soon as formed and must never be subjected to higher temperature than that at which they were formed so as to avoid cracking the oil gases into fuel gases; and that it is best to introduce superheated steam into the retort in order to increase both quality and the quantity of the oil formed. From one end of the retort, after passing through the condensers, are obtained crude oil and noncondensable gas. The crude oil goes to the refinery, and parenthetically, it may be stated, on the word of refinery men, that no difficulty should be experienced in refining this oil.

[illegible] Shale Lay[illegible] in [illegible] Bottom

Opening in Shale Hill. Here is shown the massive character of the shale when unweathered. At this spot the shale is 15 ft. thick.

The noncondensable gas, averaging around four thousand cubic feet to the ton, is then scrubbed to recover gasoline, which runs from two to four gallons per thousand cubic feet of gas, and ammonia, produced by the interaction of superheated steam and the nitrogen of the shale, and then goes to the gasometer. From the other end of the retort spent shale is discharged which still contains most of the nitrogen and all of the fixed carbon of the original shale. If this shale is immediately passed into gas producers a large part of this nitrogen and most all of the carbon can be obtained in the form of ammonia and producer gas, respectively. The gas, after scrubbing also will pass into gasometers, the gas from the two sources mentioned being ample to run the plant, thus giving an operation self-contained from the fuel standpoint, a powerful factor in commercial operation.

Shale Products

We have then two or possibly three main products to consider: Crude oil, fuel gas and ammonium sulfate. The by-products in the way of coal tar derivatives undoubtedly will be many, a little work having been done along this line but not much. Also a use doubtless will be found for part, if not all, of the spent shale, but these are problems to be worked out later. The main point is, will a profit be possible figuring on oil alone? I feel strongly that such will be the case under the proper conditions as to location of plant, method of retorting and management.

As has been stated previously some of the western states have vast deposits of shale which, because of the spectacular occurrence of the shale, have had more publicity than have our Kentucky shales. Nevertheless I have no hesitancy in saying that in all respects save possibly one, that of oil-content, and this includes cost of mining, cost of breaking, availability of water, transportation, market, climate and labor, the Kentucky shales show a marked superiority. Such being true there hardly can be a doubt that Kentucky is the logical place for the genesis of the oil shale industry in the United States, an industry which in time undoubtedly will take its place among the great industries of the country, both in its ramifications and in its financial returns.

The year 1921 was one of great difficulty in the shale-oil industry of Scotland, and without the consolidation of the industry which was carried out two years ago (when the separate concerns were merged in Scottish Oil Agency, Ltd., a subsidiary of the Anglo-Persian Oil Co.) it appears as if it would have been impossible for the shale industry to survive. With the closing of certain of the shale mines and consequent restriction in the production of shale crude oil, a considerable amount of refining plant was thrown idle, but arrangements were made for supplies of imported petroleum which enabled refining plants to be put to work, thus diminishing unemployment.

Dr. Milton C. Whitaker

Vice-President, U. S. Industrial Alcohol Company

As a Teacher at Columbia University, Dr. Whitaker advanced professional standards in the practice of chemistry in the initiation of post graduate training for chemical engineers; as an Editor he has been an influential factor in the growth of the educational functions of the American Chemical Society; as a Research Chemist, Inventor and Industrial Manager he has brought to a great industry the sound judgment and foresight that have made him a forceful figure in the councils of chemistry.

CHEMICAL
AGE

Volume 30
Number 8

August
1922

A Consolidation of
The Chemical Engineer
and Chemical Age

EDITORIAL

SLOWLY but surely is penetrating the consciousness of the American people that the dammed-up waters of economic advantage are powerless to fructify unless allowed to seek their level and, in the process of intermingling, to provide that opportunity for the largest measure of unrestricted exchange of goods and services that redounds to the greatest general good. The world thrives through trade. To seek to become a production Colossus and to make the world a customer and to hamstring its capacity to pay, is such affront to the principles of progress that the world stands aghast at the chaos and bewildered in its confusion of counsel.

The world is an economic unit. To deny to others the opportunities we demand for ourselves is to carry into international relations the short-sighted self-seeking of militant groups in our midst, which have created and would preserve economic advantage by uneconomic means. Never before in our country have we been so fed-up with the aggrandizement of groups, the domination of minorities, the dictatorship of the proletariat, that there has come, if not a degurgitation, at least a disposition to appreciate the imminent danger to our institutions that lies in such subversion of the common walfare.

Accordingly, we find the political atmosphere being cleared of the bonuses, bounties, subsidies, embargoes and divers special privileges, sought to be poured out of the cornucopia that the people are taxed to fill, and that the perpetrators of these deals see that such conduct is not conducive to their retention in office and that, however meritorious some may be, the safest course is to sacrifice them all in the general clearing of the deck. Have we got within the vestibule of an explanation of the Senate committee's rejection of the dye embargo, and of the growth of the conviction that the organic chemical industry is relying more on politics than on its own technology to retain the advantages granted by the exigencies of war?

TO succor him who would enslave us, and who even now resorts to devious ways to filch the prize of war, not only is the commandment of our common faith but is dictated by those universal laws from whose disobedience all ills flow. In all history there is no counterpart of the malefactor, impenitent and defiant, who has organized disorder to make himself powerless to paý the penalty of his crimes.

No appeal to the world's compassion has ever matched the magnitude of this draft on the bank of the world's self-interest. It must be honored though conceived in dishonor and nurtured in perfidy. This festering sore must be disinfected; this sullen culprit must be checked in his demoralization of the ideals of mankind.

ATTORNEY GENERAL DAUGHERTY'S characterization of those who know the indispensable and basic importance of the science and art of chemistry to national welfare and who are seeking to make America independent in the key essentials to her preservation, as "a powerful combination of self-constituted philanthropists," simply shows that American scientists and chemical technologists, without whom America's part in the war never could have been played, have been classed with the innumerable groups that have made conditions of the present Congress not unlike the scramble for free beer at a German picnic.

What one would believe impossible, even unthinkable, may come to pass among politicians who would sell out their country to save their seats, and with a president who would sacrifice principle in a controversy touching the very foundations of government in the desire to save the party at the polls. When traitors during the war now commend the present administration in its activities to undo the work of patriots, political intrigue comes close to the surface.

With the publicity of every move incidental to Congressional authority for the sequestration of German patent property, used in many instances against the Government which created it, the questions involved are constitutional and whose solution requires judicial determination, with its pending uncertainty to the many industries, with great aggregate invested capital, involved. Justice demands that Attorney General Daugherty should exercise the utmost promptness in the determination of the issues

---

W. B. MOORE, 41 E. Forty-second street, New York, is the secretary of the newly-organized Drug & Chemical Square Club and solicits the affiliation of all members of the Masonic Fraternity who are identified with the chemical and drug trades in New York. The new club is of the system that makes up the National League of Masonic Clubs.

Here is an aspect of the herd instinct in which broad-minded men find little basis for commendation. Is there something peculiar to chemistry that conduces to secret association and sub-rosa methods to accomplish objects that are difficult of attainment in the open? The solution of the problems of a sorely tried world only are aggravated and delayed by the activities of cliques and classes in working each other and the people to derive some special advantage. The low moral standard of the present Congress only reflects the prevailing itch to segregate and by union to levy tribute on the unorganized mass.

The tenets of Masonry are not served by secret organization in a trade to put at a disadvantage those who may not be traveling in the same direction, or to aggrandize opportunities that only those in the group may be favored. With the various industrial, commercial and social organizations already in the chemical trade, to seek to use Masonry to boost business is a perversion of the principles of the craft.

THE Society for the Refusal of Honorary Degrees is a unique organization established ten years ago by two presbyters of the Protestant Episcopal Diocese of New York, whose growth among clergymen well deserves the consideration of its purposes by chemists, as well as by all technical professional men, who see in the advertising use of an often petty distinction an abuse of an honor whose indiscriminate bestowal lowers the standard of merit which it is sought to recognize. In the field of chemistry we know that the degrees of Doctor of Philosophy and Doctor of Science are conferred upon those who complete a post graduate course in scientific study, and that much thought is being given to the standardization of such instruction that those who satisfactorily complete the course may be of a character to carry worthily the distinction.

There are instances of obscure educational institutions conferring the doctor's degree upon men who prize highly such a handle, often with little merit to warrant it, and who encourage its use in their occupation in a way that cheapens the distinction where capacity has earned it. It is known that honorary degrees have been conferred by institutions, of meagre endowment and educational service of tertiary quality, in the lively hope that there may be reciprocation of advantage to the institution, of which there is none so small but there are those who love it. There is an instance where "all the rest of the fellows are called 'Doctor'," and to provide the exception with a genuine basis for the common appellation, the degree of Doctor of Science was conferred by a college on one with no visible means of support of claims to scientific distinction.

In the growing profusion of "Doctors," time approaches when in some circles the term "Mister," which is the degeneration of "Master," will become rare; when, in the desire to appease with the most fetching appellation, the aristocracy of "Doctor" will disappear in the democracy of "Doc," as already it has done in some manufacturing plants. The whole system beats its breast and cries aloud for some sort of standardization that the "Doctor" may not become as ubiquitous as the "Colonel" and that the cognomen may not be degraded to the level of "Boss."

IT would be with chagrin if English chemists assembled at the Glasgow meeting of the Society of Chemical Industry should accept Ellwood Hendrick's cogitations as a true reflection of the understanding of American chemists of the conditions of the practice of chemistry in this country, and not, as they should be, as the garrulous tittle-tattle of abortive ideas. "The problem of the profession in America," Hendrick said, "is the great gulf that lies between the profession and business of chemistry; that chemical industry is a professional institution; but the business man dominates and unfairly is not compelled to meet any requirements as to capacity to engage in chemical business; that the weakness of American chemical industry lies in its boards of directors." All of which disparagement of the American business man in chemistry doubtless was submitted with owl-eyed profundity.

To correct the distortion conveyed to our English friends would be to repeat our monthly discussions for the past three years of the economic aspects of the practice of chemistry. We are interested, however, to emphasize Hendrick's suggestion of what he deems necessary to advance the status of the profession, viz., the administration to chemical graduates of an "Oath of Science" after the manner of the Hippocratic oath of physicians.

Hendrick apparently was much impressed with the potency of this ceremony to promote the professional status of the practictioners of chemistry. When we consider that the chemist, as a rule, is a hired man of a corporation, that provision of the oath that binds him "to address himself to the welfare of humanity, striving throughout his days to seek the light of greater understanding and to bring about a larger, a better and more abundant life for all mankind," we know will arouse either the ire or the risibilities of Otto Eisenschiml.

A PROBLEM of the profession in America is the perversion of the aspirations of the rank and file by men who capitalize its poverty of initiative in ways to suppress the only activity that will give the practitioners of chemistry professional recognition comparable to that accorded the doctor, lawyer, plumber, realtor, etc.

American chemists now realize that in independent economic professional organization, dedicated to the study of ways and means of making a living in chemistry, to the standardization of capacity and to the inculcation of popular respect which flows not to him who only knows but to him who knows how to sell what he knows, lies the solution of the material problems of the profession in America.

In September CHEMICAL AGE will be given a summary of the voting on this subject which shows to date 1,657 for and 39 against the project of an economic professional organization of chemically trained men, separate and distinct from but complementing the service of our scientific society.

The Human Element in Industry

By W. Harrison, M.Sc.

EVERYONE will agree that the influence of any one individual on a body of men with whom he may get into contact is greater the higher the position held by that individual; hence, his capacity for distributing good or evil is greater. A mistake on the part of an owner or a manager is likely to cause much more trouble than one on the part of an operative. We see, therefore, that owners and managers are, if anything, the most important human factor in industry, and until they have put themselves in order the other human factors cannot properly be balanced.*

Training for Management

One point I wish to make is that men who are intended for managerial positions should receive a training properly adapted to requirements, and one of the most important subjects is that of human nature. We must realize that a man intended for a managerial position as a rule takes less personal interest in his own education than one who has to make his own way in the world. Any teacher in school, college, or university, will confirm this. The result is that such men take up their duties with a severe handicap. Knowing the unfortunate results of this, many owners believe in putting their sons into the business at an early age. This gives them business knowledge, but it is probably the same knowledge which may have been in that business for many years, and what a young man really wants is knowledge which will help him to run the business under newer conditions. Parents should themselves take more personal interest in the training of their sons, and pay periodical visits to the institution at which they are being trained.

The Herd Instinct and Self-Preservation

Recent developments have enlarged our knowledge of the factors governing human behaviour. These factors operate in all cases, human nature being essentially the same all the world over. Self-preservation not only refers to life, but to status and position in life. Nutrition applies not only to food consumption, but to food utilisation, and is, therefore, governed by health, and by fatigue, worry, and other factors which modify health. Herd instinct has a much greater influence in life than is generally supposed. Personally, I do not think that human behaviour can be fully explained on the basis of these instincts. There are at least two other factors—the first, chemical effects within the body due to the action of external as well as internal influences, and the other, what we may call the intellectual instinct which arises as a direct consequence of the development of intellect.

Mr. Harrison's paper will appeal particularly to that rapidly growing class among the practitioners of chemistry which is giving thought to the conditions of employment of chemically trained men. Although English conditions are considered, human nature—the human factor—knows no national boundaries. The fundamentals considered by Mr. Harrison are of direct application to American conditions and cannot fail to interest chemists who seek to direct the herd instinct of their class into directions whereby it can be made of common benefit in the functions of a professional economic organization. The chaotic conditions of chemical employment and the absence of systematized co-ordination between the production and consuming fields of chemically trained help, are crying for [illegible] organization by the men themselves for themselves that their organized influence in the correction of conditions that hold them at a disadvantage in what Mr. Harrison calls "self-preservation," may be exerted constructively. If experience is the most effective teacher, it is patent to all that the neglect to collate it in an organized way for the benefit of the class is a deterrent to that recognition of the class which will come in no other way. —Editor CHEMICAL AGE.

In industrial life, self-preservation mainly refers to the preservation of one's status or position in life, and, when this can only be attended to at the expense of someone else, then some kind of warfare is bound to result, and like all other kinds of warfare the battle goes to the strong whether it be physically or mentally.

The various employers' associations, professional societies and trades union organizations illustrate the development of self-preservation in the direction of mass action primarily connected with the herd instinct. Warfare between masses is a much more serious problem than warfare between individuals and should be avoided wherever possible. Whoever wins in a trade dispute, the inevitable result is a loss of efficiency. A friendly spirit between employers and employed will do more towards increasing efficiency than any industrial dispute. If operatives are forced into what they consider an unfair bargain, sooner or later they will try to balance it. A lockout when trade is bad is met by a strike when trade is good, and both sides lose. It is human nature, and one cannot get away from it. The men are convinced that the employers wish to destroy their biggest weapon of self-defense, and that is a great stimulus to the instinct of self-preservation. An attitude of diplomacy and not challenge seems to be required.

Insecurity of Employment

Insecurity of employment is also a powerful stimulus to the instinct of self-preservation. When orders are scarce, large output means less time of employment. Hence, as a rule, workers reduce their output as much as they can or dare. Unfortunately, they do not increase their output in the same relation when trade is very good, because they lack either incentive or knowledge of the conditions. They are told when trade is bad, but not always when trade is good. The removal of this insecurity of employment would do much towards increasing output provided that rigid conditions were laid down. There is, of course, a chance that operatives might take life easy if employment were absolutely secure; hence, one must lay down some rigid conditions for permanency.

There is no doubt that individual industries could provide security of employment or insure their own workers against unemployment at less cost than by the present system of doles, for which industry has to pay through the nose in the form of taxation. Moreover, it could be done in such a manner as not to encourage laziness. It may be thought that as taxation applies to the whole of the community, industries pay only a proportion of the cost of doles, but, as the money paid by the community lessens the amounts available for the purchase of manufactured commodities, the result is a direct loss to industry as being the only source of wealth in an industrial community. Any more efficient system—and few can or will say that government systems are efficient—will eventually be a benefit to industry.

The number of cases of inefficiency caused as the direct result of faulty nutrition is far greater than is usually imagined. In the operative it causes inability to work hard, and in a foreman it may result in bad temper or general incapacity to supervise. Malnutrition may be caused by other things than wrong food, such as eating in a crouching posture, or perhaps sitting in a corner of the works. Another cause is the attempt to tackle hard physical or mental work immediately after a meal, when blood circulation is required by the digestive organs. This applies most particularly to sedentary workers and those operatives not physically fit.

---

* [illegible]

Today, business is a very complicated matter, and industrial systems have developed in most unlooked-for directions. There must be something radically wrong with an industrial system which leaves half the operatives unemployed and the other half suffering from discontent. To remedy this requires a man with training which adapts him for diagnosing the cause of industrial unrest and curing it with the same degree of certainty as a qualified doctor diagnoses and cures diseases of the human body. Unfortunately, industry has been like the sick man who would not admit himself sick until he was unable to carry on. The result is that no doctors have been called in, neither has there seemed sufficient demand to encourage men to qualify themselves for the work. The result is that industrial troubles have gone uncured and therefore become worse. Even today, with big troubles before us and these growing larger every year, practically no men are going in for the study of those subjects which would assist in the cure. We try to settle the troubles with household remedies and feel surprised when they break out again in more virulent form.

The Herd Instinct and Intolerance

The herd instinct plays a much bigger part in industry than appears at first sight. According to Trotter, on account of this instinct, men are intolerant and fearful of solitude either physical or mental. This intolerance is the cause of the mental fixity and intellectual incuriousness which he constantly displays to an extent very remarkable for an animal with so large a brain. The resistance to a new idea is primarily a matter of prejudice, the development of intellectual objections, just or otherwise, being a secondary process, in spite of the common delusion to the contrary.

It is not only the workpeople who object to the introduction of a new machine in a works. Many owners and managers are quite as difficult to convince on the value of a new machine, and they are always ready to produce the excuse that the workers would not take to the new idea. Once a machine maker has sold a few machines, he proceeds to inform a probable customer that so-and-so and so-and-so have bought it. The herd instinct comes into play and the machine is bought not because it is an efficient machine, but because so-and-so has one.

Leadership and the Herd Instinct

Man on the average is more sensitive to the voice of the herd than to any other influence. It is the source of his moral codes. It can endow him with energy, courage, and endurance, and can as easily take these away. During the war, we saw men moved to energy, courage and endurance by this very instinct, and, after the war, we saw the same men moved to slackness doubt, and discontent.

One must remember that the herd follows a leader, but he must be one of the herd. A leader from another herd of an entirely different class is seldom followed. Hence, to influence the crowd one must associate oneself with it, become one of it, at least for the time being. I am fully convinced that the workers can be influenced in the right direction just as easily as they are now influenced in the wrong, solely by virtue of the herd instinct. One must not forget, however, that this instinct moves men of all classes. Employers have been led into wrong actions against the workpeople, often against their better judgment, but having voted in favour of the action when influenced by the voice of the herd they feel they have no choice but to keep their word—in fact, keeping one's word is also an action caused by the herd instinct.

One cannot get away from the effect of this instinct unless one is prepared to face the consequences. To act in a manner entirely contrary to the herd results in one being ignored and to have to face that solitude which the herd instinct makes intolerable to man. Thus does the human being, moved by the herd instinct, react towards his fellow men should they be tainted with originality or react to knowledge instead of to instinct. Yet, the world would not make much progress without those persons "cursed" with originality. The herd instinct wants a curb put upon it, and that can only be done by conscious effort after fully recognising its actions. Intellect is the only counter to instincts.

The Need for Broad Education

The need for broad education was never greater than it is to-day, and by broad education I do not mean that memory training and memory examination system of to-day which we are led by the herd instinct to believe is true education. I mean training of the logical faculties, which, unfortunately, is neglected for the sake of red tapism. When we say that the education which was good enough for us is good enough for our sons and grandsons, we are acting in response to herd instinct and not to reason. Reason tells us that the world is changing continuously, and that education must necessarily change with the times.

The Square Peg in the Round Hole

Of the large number of persons engaged in industry, few are in the position for which they are most fitted. Many persons accept the advice of friends or relatives and choose the wrong occupation; others follow the occupation of their father or grandfather, very often under compulsion of one kind or another. Others are actuated by expected influence or attracted by interest and imagination to occupations for which they have no real aptitude. Thus efficiency is minimised. Little blame can be attached to any of the employees.

The Surplus Animal Population of Great Britain

In the early days of the war there was a big demand for chemists and a great deal was said about the future of chemistry. This year, there are nearly 2,000 young men studying chemistry, whilst last year and the year before the number was greater. Thus, at least 5,000 men have been trained as chemists since the war and there are not openings for one-tenth the number because the value of a chemist in industry is not understood. I think we ought to advise the colleges and universities concerning the kind of man we are likely to want in the next few years so that such a surplus of specialised service cannot arise.

Personally, I think specialisation in the colleges and universities should be avoided. A man has to make the best of the opportunities which arise and not wait for an opening specially suited to his training. Adaptability, backed by general knowledge, is the best foundation for a business career. If a boy has special abilities these ought to be cultivated fully, but other possibilities should not be neglected. The completion of a business training should take place in the factory where the variety of occupation leaves open the opportunities for adaptation to particular jobs.

The Human Factor

The human factor in industry is a very much bigger thing than is usually imagined. The condition of industry to-day, or at any time, is not due to any single human factor but to the action and interactions of the various human factors on one another. The actions of every section are governed by circumstances modified as they are by the various instincts to which man must react. The action of any one section necessarily produces a reaction in the other sections which tends to balance the first in the attainment of equilibrium.

The idea that business is ruled solely and entirely by economic law is a fallacy which ought to be got rid of as soon as possible. Based on the arguments of economic law, we construct business in such a way that commodities are manufactured quicker than purchasing power is distributed. Douglas concludes from this that manufactured articles should be sold at less than the cost of manufacture so that purchasing power in the form of wages should be distributed as quickly as commodities. Operatives, on the other hand, conclude that output must be restricted so that commodities are made as slow as purchasing power is distributed. As both of these are logical conclusions based on economic law and as neither remedy appears sound to business men, it follows that economic law is either unsound or not the main factor in business.

Chemical Foundation Patent Royalties

The sums involved in the friendly actions instituted by the Chemical Foundation, Inc., against various concerns operating patents under licenses granted by the Federal Trade Commission, which later the Alien Property Custodian sold to the Foundation, are given in the accompanying table. The purpose of the actions, as is well known, was merely to establish title to the funds, long paid by the licensees, and held by the U. S. Treasurer as custodian, who necessarily was joined as codefendant. It is these actions to determine the disposition of the funds enumerated that, the Alien Property Custodian claims, precipitated the Government's demand for the return of the patents.

In the letter of Nelson B. Gaskill, chairman, Federal Trade Commission, which compiled the figures, to U. S. Senator George W. Moses, at whose request the information was provided, Mr. Gaskill states "these figures do not represent and must not be confused with aggregate royalties accruing under all licenses of the same nature or otherwise, as these figures refer only to such patents as have been assigned to the Chemical Foundation. The figures do not in every instance show the full amount involved as of a closing of the books on this date, because a number of reports covering the semi-annual accounting period ended July 1, 1922, have not yet been received, and are not herein included."

Licensee	Product.	Total royalty accrued.	Accrued prior to transfer to Foundation.
The Dermatological Research Laboratories, Phila., Pa.	Arsphenamine and Neo Arsphenamine (introduced as Salvarsan and Neo-Salvarsan, respectively).	$87,975.39	$35,447.73
Takamine Laboratory, Inc., New York City.	..do	8,321.31	1,574.92
Farbwerke Hoechst Co., New York City	Arsphenamine	6,203.23	6,203.23
Do	Neo-Arsphenamine	None	None
Do	Procaine (introduced as "Novocain").	3,812.88	3,812.88
Rector Chemical Co., New York City.	do	8,355.22	5,756.77
Pacific Flush Tank Co., Chicago, Ill.	Sewage treatment (Imhoff)	12,954.20	7,842.80
Diarsenol Co. (Inc.), Buffalo, N. Y.	Arsphenamine and Neo.	31,852.35	17,008.61
The Abbott Laboratories, Chicago, Ill.	Procaine	3,946.52	1,638.20
Lembcke von Bernuth Co., Inc. (now Bernuth Lembcke Co., Inc.), New York City.	Impregnation of wood (Ruping)	47,178.92	21,603.73
Calco Chemical Co., Inc., Bound Brook, N. J.	Procaine	[illegible]	None
The Abbott Laboratories, Chicago, Ill.	[illegible]	[illegible]	[illegible]
E. I. du Pont de Nemours & Co., Wilmington, Del.	Anthracene dyes	10,103.88	None
Do	Indigo	61,884.98	None.
Albert B. Moses, Seattle, Wash.	Artificial milk	1.10	None.
E. C. Klipstein & Sons Co.	Solid hydrosulfites	26.42	21.81
National Aniline & Chemical Co., New York City.	Anthracene dyes	88.62	None.
Do	Sulphur dyes	17.11	None.
Do	Azo dyes	4,284.80	146.29
Merrimac Chemical Co., Boston, Mass.	Solid hydrosulfites	382.27	None.
H. A. Metz Laboratories, Inc., New York City.	Arsphenamine	31,684.81	13,408.59
Do	Neo-Arsphenamine	102,826.97	3,659.63
Do	Procaine	21,097.82	7,901.30
General Ceramics Co., New York City.	Absorption tower	953.03	202.39
E. C. Klipstein & Sons Co., New York City.	Tanning agents	7,921.77	3,221.20
Merck & Co., New York City.	Digitalis extract	6,928.61	77.88
The Draeger Oxygen Apparatus Co. (now American Atmos Corp.) Wilkinsburg, Pa.	Artificial breathing apparatus, method causing artificial respiration.	382.88	246.50
Do	Resuscitating device	661.25	504.50
Do	Battery for absorbing carbonic acid, such as used in breathing apparatus.	3,570.67	2,661.83
Do	Portable breathing apparatus universal coupling.	36.06	7.28
Do	"Pulmotor" trade-mark	300.00	35.00
Reinschild Chemical Co., Manhattan, N.Y.	Agar-Agar cascara product and process of making same.	10,678.21	1,728.34
The Ault & Wiborg Co., (transferred to Cincinnati Chemical Works, Inc.), Cincinnati, O.	Red azo lake	3,254.34	712.06
Ultro Chemical Corporation, New York City	Blue red lake and process of making same.	3,946.44	192.47
Division of Laboratories and Research of N. Y. State Dept. of Health, Albany, N.Y..	Arsphenamine	291.03	None.
Total		$491,855.70	$135,765.91

SUMMARY

Aggregate accrued under licenses	$491,855.70
Total accrued prior to transfer to Foundation	135,765.91
Total accrued since Foundation took title	356,089.79

(Note.—The above figures do not represent the full amounts involved, as a number of reports are not yet in for the semi-annual accounting period ending July 1, 1922.)

In celebration of the centenary of the birth of Louis Pasteur, Dec. 27, 1822, at Dole (Jura), France, an International Exhibition of Hygiene will be held at Strasbourg, under the auspices of the university and city and with the patronage of French political and scientific dignitaries, from June to October, 1923.

Chemical Segregation in America

WE are in receipt of a letter from a Chicago chemist who states: "We believe that the American Chemical Society should answer all the needs of the American chemist. Those of us in this part of the country who have been interested particularly in the American Chemistry Society see a better day for it in the near future. I believe that the formation of a new organization would be uneconomic and really unnecessary. I believe that there is room in the Society for all the departments necessary for taking care of the situation if every one were to work with a will in this direction."

Another Chicago chemist, a technical director of a nationally known enterprise and an employer of many chemists, to whom the letter was submitted, stated that such is the "talk" among the element which interests itself in the administration of the Society but, like Mark Twain's observations about the weather, nothing is ever done about it. He added that those in control of the scientific society do not want the injection into it of a labor problem among scientifically trained workers, which they foresee in the cultivation of a professional economic organization of chemically trained men. He further stated that a scientific society dominated by the employing element was no suitable environment in which to work out the problems of the chemists' material welfare, and that the limit of discouragement and obstruction to the formation of an independent organization of well-defined purposes which could work in close co-ordintion with the educational society, had about been reached.

These opinions are the *pro* and *con* of the proposal of an economic organization of chemically trained men designed to give systematic study to the problems of making a living in chemistry and dedicated solely to helping the individual member.

The Repetition of History

It is unnecessary to repeat what already has been set forth, viz., the striking identity of the opinion first stated to that which prevailed with many in the Chemical Socieity of London over forty years ago when was discussed the subject which eventuated in the Institute of Chemistry of Great Britain, whose growth and service have detracted in no way from the development of scientific chemical organization in Great Britain, but which in fact has aided it by permitting less distracted application to the latter's purpose.

In the perspective of forty years looms large the futility of a conviction that one society in a nation should answer all the needs of its chemists. It is the projection of this monopolistic spirit of the segregational activities of American chemistry, encouraged by those who have most to gain by it and promoted by those who follow sheep-like in the wake of those who know what they want, into the broader field of national economy that has led to the present undoing of plans, conscientiously and properly cultivated, to conserve the progress of the technologist and the business man in chemistry.

Let our scientific chemical society be the tail to the political kite of the commercial interests of the art, but let it retreat gracefully from the position that such organization is so constituted and qualified to perform all the pressing duties that the practice of chemistry demand. The use of our scientific chemical society in the acceleration of public opinion, however ineffectual in the minds of many it may be, is legitimate, but in the cultivation of monopolistic attributes in all that concerns the practitioners of chemistry, its administrators are over-reaching themselves, in confirmation of which we do not have to turn to retrospection but to daily observation.

Specialization of Functions Is the Order of the Age

Those who believe that oil and water will mix "see a better day for the American Chemical Society in the near future." Those who believe that precedent and natural law should be observed and that efficiency in service should be cultivated by specialization of functions, see that the American Chemical Society should be held true to its educational service, the like of which is not found elsewhere, and that it should not be burdened further by bureaucratic, clique-controlled functions incompatible with its original purposes.

The greater loyalty to our scientific society is displayed by those who advocate the formation of an independent economic organization of well-defined purposes. They are not animated by ulterior motives; they have no axes to grind; they wish to leave our scientific society in the hands of those administrators to whom honor is due for the creation of one of the most powerful educational agencies in science. They wish their successors to be similarly qualified and not to seek after place and power with the idea, if not to pervert this great agency, at least to engraft upon it multitudinous responsibilities from which it either will collapse with complexity, or persist as an unwieldy body filled with wind, which our Chicago friend dignifies as "talk." Common sense and history confirm the soundness of their position.

The Undesired Is Always the Unnecessary

The belief "that the formation of a new organization would be uneconomic and really unnecessary," however conscientious those who entertain it may be, is, on the one hand, an admission of poverty of the instinct of service and, on the other, a display of egoism without which a scientific educational society could not exist. Furthermore it indicates a loose grasp of the significance of organization as a means of growth, and is a confession of the believer's attitude toward such an instrument.

Duplication of functions should be avoided in segregational activities just as carefully as the omnibus absorption of all functions by a single organization, for in each direction lie perversion and waste of human effort, which always is the core of unsatisfactory service. The determining factor is the welfare of the individual and the problems presented by his environment and his helplessness individually to solve them. Practical men want power in a society for the profit possible, so we find salesmen and representatives of special interests, whose scientific attainments are confined to voluble familiarity with the properties of products made by their corporations, in positions of strategic importance from the standpoint of the salesmanager.

Power flows to men willing to assume responsibilities and, if they do the work of the organization they are entitled to whatever credit or advantage may lie in such prominence. The point we wish to make is that one man can not be in two places at once. As a worthy and highly respected chemist, whose death was a great loss to the profession of chemistry, said, "the project of an economic organization of chemists is absolutely sound and is needed, but I can't ride two horses at once."

Men satisfied with things as they are want nothing to disturb their even tenor. They have arrived, are in control, or are satisfied with it and have lost sympathetic touch with a younger element which has come up in greater numbers than in the formers' youth and in an economic environment quite different in its demands. The scientific trend of mind prevails in this class and appreciates only with difficulty that salesmanship is the attribute now dominant as never before, but nevertheless believing even in this that instruction can be handed out by the scientific society.

Economic Service Is the Need of the Chemist

The type of men most needing help, such as an economic professional organization of their kind can provide, is the educated technical man filled full of facts which he does not know how to sell or is using to poor advantage. The scientific society can not provide this service; it admits this deficiency by its encouragement of secret organization within its body, pledged to the mutual material aid of its members, and by the reward of jobs and prizes to the faithful of the system. To the bodies that make up the solar system of the scientific society, naturally "a new organization would be really unnecessary," but just as astronomers foretold a new planet from the existence of influences that could proceed from nowhere else, a new organization dedicated to helping the chemically trained man to sell his services to the best material advantage, to standardize his capacity and to give his vocation a professional status, is in process and of equally certain eventuality.

However satisfactory a form of government it may be for a scientific society, the day is past in the material relations of men when men exist for government. In the economic society the government exists for the membership and is directly and quickly responsive to its needs. The unsatisfactory situation in the practice of chemistry, and for which, with the rapidly increasing accessions to the class, we can expect no alleviation, is perturbing because no institution exists for providing the service called for by the conditions. To those who appreciate these conditions and familiar with the administrative practice of our scientific society and with a large fund of illusory hope, the belief is natural "that there is room in the Society for all the departments necessary for taking care of the situation *if* any one were to work with a will in this direction."

Not Aggrandizement of Functions in an Unstable Bureaucracy

The subjunctive mood is the critical, fatal factor in the administrative efficiency of bureaucracy. The absorption of added responsibilities by a largely moribund organization, kept on its feet entirely by the activity of a group whose participation in its administration is motived by personal advantage and by the choice salaries of its "cheer-leaders," is surrounded with such uncertainty of satisfactory performance as to make inadvisable the attempt. The responsibilities are too great, too diverse; they call for leadership of a type that is not in action in a scientific society controlled by the corporate employing element. Furthermore would be lacking that opportunity and freedom of exercise which would be expected in an organization of hired men. The psychology of such association is repellant of assurance of satisfactory performance.

Men must be taught to help themselves and, in the fulness of their self-benefit by such exercise, to share their favor. Chemically trained men need experience in the work of organization and can be assured of the optimum results of such affiliation in an organization dedicated to the promotion of their material welfare and created by themselves. Precedents exist all around them and the need of the service of such an organization is recognized by every alert man identified with chemistry. Shall it be an independent organization of and by and for the men themselves, wielding the weight of organized influence, or shall it be an employment agency under the auspices of our scientific society? Here is a situation confronting every progressive man in chemistry that calls only for sound leadership to make the movement coalesce into organization which would be the most constructive influence in the establishment of the professional status of the chemically trained man in industry.

SECRET BALLOT ON THE AMERICAN INSTITUTE OF CHEMISTRY

No Signature—No Condition—No Obligation

MARK (X) IN ONE SQUARE ONLY

I favor and urge the establishment of an economic, professional organization of chemists separate and distinct from the American Chemical Society as our educational society, but complementing it in service to American chemistry. ☐

I do not favor any distinctively economic organization of chemists and condemn any organized aid to the American chemist in the solution of his material problems, other than what now exists. ☐

It Is Important to Mark and Return This Ballot Immediately

Staff of Food Research Institute

In conformity with plans of the directors of the Food Research Institute of Stanford University, published in May Chemical Age, that its work would be fully under way by the autumn of 1922, Dr. Carl L. Alsberg has announced the personnel of the staff already selected. Since its founding in February, 1921, and the selection of its directors in April, 1921, the directors who embrace, in addition to Dr. Alsberg, Joseph S. Davis and Alonzo E. Taylor, have been occupied with working out the basic plans and policies and the organization of personnel.

The two special investigators and research assistants appointed comprise:

Wilfred Eldred, Ph.D., Harvard, recently professor of economics, University of Virginia, who for nearly a year has been carrying on investigations in the baking industry for the Institute.

John L. Simpson, A. B. (California), who in 1919 was liaison officer of the food section of the Supreme Economic Council and chief of the A. R. A. Commission to Serbia, and in 1920 was special correspondent to the New York "Evening Post" for Eastern Europe.

Susan B. Burr, A. B. (Vassar), A. M. (Stanford); Franklin D. Schurz, A. B., M. B. A. (Harvard), and A. G. Silverman, A. B. (Harvard).

In addition five fellowships have been granted to the following persons: Edith Hawley, A. M. (Columbia), a graduate student at Columbia for the past two years; James N. Holsen, A. B. (Indiana), A. M. (Princeton); Olaf S. Rask, A. B., B. S. (Minnesota), a graduate student at the University of Minnesota and formerly a research chemist in the Bureau of Chemistry, United States Department of Agriculture; William B. Stewart, A. B. (Reed), a graduate student at the University of Illinois, and Conrad P. Wright, A. B. (Oxford), a graduate student at the University of California.

Future Methods of Organic Chemical Manufacture

By Dr. E. K. Strachan

Assistant Professor of Physical Chemistry, Brown University; Formerly Chemical Engineer, National Aniline & Chemical Co.

I THINK that we chemists would profit if we took Jules Verne a little more seriously. The business man, salesman, stock promoter, and many others have imaginations that should put the chemist to shame. Their imaginations frequently exceed the best that they could ever hope to do, while ours almost always fall far short of the wonders that we might perform. Then we must have faith in ourselves, and in our science. I think that the chemists who have come to my laboratory in the past five years have been more lacking in imagination and faith than they have been in technical knowledge and industry. The chemical independence of our country depends more on our doing things differently from what is done abroad than it does on anything else. We cannot become independent by copying.*

I imagine that the future industrial organic chemistry of America will depend on plant breeding and culture, bacterial action, catalysis, electrochemistry and new chemical machinery. Those chemical processes afford promise of future greatness which are most conservative of power and materials and labor. The most conspicuous of such processes are the life processes; it is they that are the most efficient. Why not grow our chemicals? Plant breeding has yielded a variety of corn rich in starch, also a variety rich in oil. The sugar beet, as everyone knows, was developed years ago to yield many times the amount of sugar that it did in its natural state. Plant breeding of indigo has recently improved natural indigo to a point where perhaps it will compete with manufactured indigo in shade and price. These performances are all tame compared to the achievements of Burbank. Organic chemistry needs a chemical Burbank.

Bacteria are the most lowly organized of plant life; they work quietly and efficiently, propagate themselves, require no added power, and little supervision. The bacteria were the originators of the fixation of atmospheric nitrogen. If the catalytic and electrical methods of nitrogen fixation are to have any competitors at all they will be the bacteria. Who knows if we study the bacterial method of atmospheric nitrogen fixation as thoroughly as we have the catalytic and electrical ones, it may be the latter methods with their larger power consumption and elaborate apparatus will be discarded in favor of the simpler method of the bacteria. This is worthy of serious consideration, since next to power supply, fixed nitrogen is the most important chemical and engineering problem.

It may be we will find bacteria that will unlock the vast amounts of potash that are now imprisoned in the feldspar rocks. The bacteria, yeasts and moulds produce fine chemicals also. All of the unsaturated aliphatic alcohols up to caprylic have been produced by fermentation processes, and no one knows how much farther in the series we can go. Bacteria have a diversity of chemical methods at their command. Before long we will undoubtedly replace many of the violent, destructive, expensive reactions of the present by the gentle, silent, cheap, efficient work of the bacteria.

Organic electrochemistry hardly ranks on a par of importance with some of these other lines of work, but I am convinced that it is going to receive a great deal more attention in the immediate future than it has in the past.

Yankee ingenuity is a by-word the world over. We American chemists ought to shine in this respect, if we expect to be superior in any respect at all. There is scarcely a machine or mechanical operation connected with chemical manufacture that cannot be improved in materials, construction, or method of operation. The harvest is ready for the reaping by any engineer who is in search of a problem.

Let no one think that he can achieve superiority in modern chemical manufacture without a thorough appreciation of the spirit of physical chemistry. Chemical engineering is applied physical chemistry. Let us remember to leave no tool unemployed, or a stone unturned in our endeavor to establish the chemical independence and leadership of our country.

Catalytic processes are the closest approximations to life processes. They constitute a chemical method that is just beginning to come into its own in the organic industries. The oil hydrogenation business is a portent of what we may expect of other catalytic processes as yet undiscovered or undeveloped. I am tempted to think that in the future we may perform all of our reductions by catalytic hydrogenation, and our oxidations by use of air and a catalyst. Or, in view of recent work that shows that carbon monoxide can be oxidized at room temperature by water in the presence of paladium to carbon dioxide and hydrogen, we may make catalytic oxidations with water and use the hydrogen produced thereby for catalytic hydrogenation. Perhaps we can discover substances that will catalyse the life processes of plants and bacteria, and control their action in the same way that the secretions of the ductless glands control the activities of the animal body. Notwithstanding all the study that has been devoted to the catalysts, they present an almost virgin field of work.

Technicolor, Inc., is a Delaware corporation of 400,000 shares, all common, which will hold 192,000 shares of the 330,000 outstanding shares of the Technicolor Motion Picture Corp., which owns the patents for the production of colored motion picture film of a clearness and quality claimed to be unequalled. The process was developed by Daniel F. Comstock and Herbert T. Kalmus, research engineers of Kalmus, Comstock & Westcott, of Boston, who were engaged by W. H. Childs, president, Allied Dye & Chemical Corp., to perfect the idea when first brought to his attention.

A plant will be built near New York with a weekly capacity of 1,000,000 feet. A plant with capacity of 50,000 feet weekly is being operated in Boston. The company will be devoted exclusively to manufacture of negative and positive films in colors and will not produce pictures or employ actors.

Directors of Technicolor, Inc., are as follows: William Hamlin Childs, Eversley Childs, William Coolidge, James C. Colgate, of J. B. Colgate & Co.; C. E. Danforth, of Van Emburgh & Atterbury; Frederick Ecker, vice-president, Metropolitan Life Insurance Co.; A. W. Erickson, president of Erickson & Co. and of Congoleum Co.; N. T. Pulsifer, President of Valentine & Co.; Alfred Fritzche, Thomas W. Slocum, of Minot, Hooper & Co.; Herbert T. Kalmus, and William Travers Jerome.

---

*Yale Alumni Weekly, Chemical Number, May 1[illegible], [illegible], featuring the dedication of the Sterling Chemical Laboratory, described in CHEMICAL AGE, August, 1921.

Use of Sulphite Cellulose Extract to Fill Sole Leather

The importance of utilizing the wood substance contained in the waste sulphite liquor, which at one time was discharged from the pulp mills as useless waste, is evidenced by the large amount of research which has been conducted on the subject in every wood-pulp-producing country.

One of the principal methods proposed for utilizing these waste liquors is the production of sulphite cellulose extract for use in making leather. This use of the material has been discussed with considerable interest, resulting in a remarkable diversity of opinion. It has been stated that the extract does not contain tanning properties, and hence is not a "true" tanning material as are such vegetable materials as oak bark, quebracho, and chestnut wood. It is generally considered that the material contains no tannin. However, experiments have shown that a hide treated with certain of the sulphite extracts will absorb as much as 25 per cent of substances which will preserve the hide, which is the essential function of a tanning material.

There are many different methods for treating the waste liquors to produce an extract for use in making leather, and hence there are correspondingly many different products. This may account in some measure for the varied results obtained from their use by investigators. Whether it is proposed to use the material either in tanning or filling, the waste liquor should be treated to remove such substances as iron and lime, which have a detrimental effect on the leather.

American tanners have not been successful in their attempts to tan hides with sulphite cellulose extract, and it is generally considered as having no place in the tanyard. It has found, however, a wide application as a filling material in the manufacture of sole leather. After the hides have been thoroughly tanned in the yard they still lack the firmness and weight required. It is the general practise to produce these qualities by filling the leather with tanning materials by drumming, tempering, and dry dipping.

Since the opinion has often been expressed that sole leather filled with this extract was inferior, and since no data on the subject were in existence, the Bureau of Standards undertook an investigation to determine the comparative durability of sole leather filled with sulphite cellulose extract and sole leather filled with the ordinary vegetable tanning materials.

Four lots of leather were prepared and tested to determine the comparative durability of sole leather filled respectively with sulphite cellulose extract and with the ordinary tanning materials such as chestnut wood extract and quebracho extract. Physical data obtained as to the actual service tests and chemical analyses of both the new and worn soles failed to disclose a quality difference between the two leathers.

As a result of these tests the following observations have been made in *Technologic Paper, No. 215*, regarding the sulphite cellulose extracts used in the investigation as fillers for sole leather:

Leather filled either partially or entirely with sulphite cellulose extract is as durable as leather filled with the ordinary tanning materials, such as chestnut and quebracho. As reflected by the chemical analyses, the extract is equally as firmly fixed in the leather as these vegetable tanning materials. The use of sulphite cellulose extract instead of chestnut and quebracho would conserve the latter materials for use in the actual tanning processes for which they are suitable and for which sulphite cellulose extract has not been successfully used.

It is probable that sulphite cellulose extract could be used as a filler in place of the more soluble glucose, thereby producing a more waterproof leather. Leather filled with this material can be made which will have as light and uniform a color as leather filled with the ordinary materials. Using this material as a filler has no more effect on the aging of the leather than the ordinary materials, since samples of these leathers which have been in the laboratory for over two years are still in a satisfactory and pliable condition.

Petroleum Cracking Patent Infringement

The Standard Oil Co. of N. J. has instituted action against the Pure Oil Co. of Ohio, in the U. S. District Court for the Southern District of Ohio, for alleged infringement of the Ellis process of cracking oils under pressure in its refinery at Heath, Ohio. The Cross process was installed by Pure Oil Co., patent for which is owned by the Gasoline Products Co. 52 Broadway, New York. In explanation of its action the Standard Oil Co. announces that it was made necessary by the refusal of certain interests in the oil industry to respect the rights vested in the company by the grant of the Ellis patents. The company has no desire to maintain a monopoly of the use of this type of process or to impose burdensome or discriminatory terms of license. The process is well adapted to the needs of the small refiner.

The fact that the Standard Oil Co. of Indiana is the owner of the patents on the cracking process known as the "Burton Process" and that the Standard Oil Co. of N. J. has been for many years a licensee under these patents, has recently been interpreted in some quarters as an indication that there was some community of patent interests between the Standard Oil Co. of N. J. and the Standard Oil Co. of Indiana. There is no such community of interests. The Standard Oil Co. of New Jersey by its own research and development work, and by the acquisition of inventions of outside workers, is in control of a type of cracking process which is in some respects competitive with and in some respects complementary to the "Burton Process." The cracking method developed by the Standard Oil Co. of N. J., which is identified as the "Tube and Tank Process," has been handled by that company on its own merits and quite without regard to the Burton patents, in which this company has no interest save that of a straight licensee. It is willing to grant licenses to others without respect to whether or not they are using the "Burton Process" as well.

Cupra Silk Co., Inc., Paterson, N. J., organized by R. Dicks, of the Dicks-David Co., and Henry Doherty, of the Doherty Silk Co., Clifton, N. J., and others, will undertake at once the erection of the first unit of its new plant, to cost about $500,000, for the manufacture of artificial silk. Plans call for the construction of four units.

* * *

The quick absorption of an issue of $3,000,000 first mortgage 7 per cent. sinking fund bonds of The Newport Company, Carrollville, Wisc., at 98½ to net 7.20 per cent., indicates confidence in the management and prospects of this company. The Newport Company transforms into synthetic organic chemicals the by-products of the Milwaukee Coke & Gas Co. and completes a system which starts with ownership of coal lands and embraces allied interests. The growth of the company has been one of the notable accomplishments of the synthetic organic chemical industry.

Current Chemical Patents and Patent Problems

By Lloyd Van Doren, Ph.D.

Consulting Chemist; Patent Attorney, The Chemical Foundation, Inc.

IN deciding whether to patent an invention or to keep it secret, the inventor first of all must decide whether or not he is willing to lose the right of excluding others from the use of the invention because of the possible difficulty in detecting infringement. If he decides to forfeit this right and depend for his protection on keeping his invention secret, he must make the fact of secrecy evident and must rigidly bind to secrecy those to whom he imparts the information necessary to enable them to work the invention. From the standpoint of a chemist, the question of trade secrets arises almost invariably out of the production of a new material or out of the development of a new process of making an old material. The history of industrial chemistry shows that some one always can be found who can find out what the new material is or what the new process is by legitimate investigation and analysis. When this is done, the secret is lost, usually to a competitor, and the protection of secrecy is lost with it.

Probabilities of Secret Operation

An interesting situation may arise when one who has kept an invention a trade secret for a number of years, attempts to patent it. Such an inventor is not looked upon favorably in the courts nor in the Patent Office in case of conflict with an independent inventor. As early as 1858, the Supreme Court expressed the thought that one who designedly and for his own profit withholds an invention from the public does not come within the policy nor objects of the Constitution and Patent Acts. Instead of promoting the progress of science and the useful arts, he impedes it.

The Patent Office takes a similar attitude, and will not permit an inventor who has concealed his invention to set up an earlier date of completion of the invention against an independent inventor who has applied earlier for patent. Keeping an invention a trade secret may hence involve the loss of patent rights and, what is worse, their acquisition by another. If the secret user does secure a patent, its validity is very doubtful. It has been held, in at least two cases, that a patent secured by an inventor on a process operated as a secret for a number of years was invalid because of that use in secrecy.

Relative Advantages of Secret Operation and the Patent

In brief, a trade secret has only one possible advantage over a patent, viz., there is no public disclosure of its subject matter. On the other hand, the protection afforded to a trade secret is limited and uncertain because it extends only to those confidentially entrusted with the secret. The secret use creates no rights against the independent discoverer who may patent its subject matter and thereby destroy the rights of the secret user. In fact, the secret use creates disadvantages in enabling a later inventor or discoverer to acquire superior and dominating rights and even invalidating a patent which may be issued to the secret user upon an application for it filed after any unduly long period of secret use.

Furthermore, the thoughts above expressed may be extended to include those cases wherein there has been an unnecessary delay in filing. Many instances have arisen in which the inventor, having delayed his filing, has found himself confronted by the fact that applications already have been filed, or that patents just recently granted cover what he considered to be his invention, and which would have been his had he not followed dilatory tactics. Hence, both individuals and corporations should present their inventions in the form of an application to the Patent Office at the earliest possible date after completion. Delay by the inventor sometimes is encouraged in the belief that thus there is secured a practical extension of monopoly. But this is fallacious as not any monopoly exists until the patent is granted, and such a course of action frequently has been the cause of much loss, rather than gain.

Deficiencies of the Lambert Bill

The passage of the Lambert Bill, while a just and needed step in the direction of correcting demoralizing employment conditions in the Patent Office and removal of the congestion which have greatly hampered the transaction of its business, was hailed with acclaim in many quarters. Practical operation under some of its provisions, however, leaves much to be desired. In examining its effects with respect to salaries certain incongruities appear. That the working conditions within the Patent Office still present ample opportunity for betterment is clearly evidenced from the following statement by one who has been in the Patent Office for several years.

"The Patent Office has been struggling under difficulties for many years to retain a competent force to keep its technical work up to a standard. This struggle was directly due to the inadequate compensation allotted by near-sighted Congress to men who require the highest technical training to solve the many intricate questions of patentability. Notwithstanding these facts, the standard of work done by the department was of the very highest class. During the world war, the force was depleted by the golden opportunities offered by manufacturers who recognized the value of trained men. Of course, there were quite a few men who stuck to the then increased burdens, like Lawrence to his ship, prompted by patriotism and in the hope that the bill then before Congress for the betterment of the Office would be passed.

"After the war there was a bill introduced in Congress as a substitute for the various bills that had been buffeted by Congress for the last five years. This bill was passed by Congress only after American manufacturers brought the crying needs of the Patent Office forcibly before Congress. After years of struggle, the Patent Office employees had been rewarded for their faithfulness. The bill had passed. There was much expectancy running through the Office and everybody was congratulating everybody else, except the $1,800 clerks, who were not provided for. But the cruelest joke in the history of the Government was brought to light and the employees found themselves little, if at all, benefited by the bill which they had so long looked forward to.

"The provision in the bonus bill that no employee should receive the bonus who had received an increase of $300 or more during the fiscal year was applied to the Patent Office employees and consequently some of the technical men who had carried the increased burden of the Office through the war received an increase of $3.75 per year. The assistant chiefs of divisions received sixty dollars per year (after being promoted, $300), more than the $1,800 clerk who had not been promoted. The best copyists were promoted from $900 to $1,200, while the remainder were promoted from $900 to $1,100. The former, not being entitled to the bonus, now receive $1,200, while the latter, having been increased only $200, receive the bonus, making the salary $1,340.

"There are many other such ridiculous instances, but the above examples are sufficient to prove the utter failure of the bill in the respect noted. Notwithstanding these circumstances, the fees for applications and for recording assignments have been increased to meet this increase (?) in salaries, but the result will be only an increase of the seven million surplus now in the Treasury.

"Referring to the antiquated building in which the Patent Office now labors, and in which the most valuable scientific records are stored, it is hard to conceive how Congress remains blind and turns a deaf ear to all suggestions for a modern and fireproof building for the Patent Office, in which to preserve these priceless records. At present, the records are stacked and crammed into wooden shelves and in every conceivable corner, and when a change is made to make room for the increased work, it is a matter of figuring in inches. The present building is overrun with rats, which are eating the bindings off the record books, and the Office has no means available to combat this menace.

"Recently, all spittoons have been removed from the corridors because there is no help available to clean and attend them. This condition has a two-fold menace, endangering health and increasing the danger of fire. Disregarding the first, because the employees are immune from germs, owing to the insanitary building in which they have been laboring, it seems criminal to add this new risk of fire by not providing receptacles in the corridors where the records are stored for the disposition of cigar and cigarette stubs.

"It must be said, in justice to the employees of the Patent Office, that notwithstanding the way in which they have been treated and the deprivations they are suffering, the most remarkable results are continuing to issue from the Office, and these results can be attributable only to the loyalty of its employees whose morale has been held together by patient officials of the Office under extremely trying circumstances. It is only by this continued loyalty of its employees that this result can continue, and it is to be hoped that relief of some kind may be injected into this vital organ of American industry before it is too late."

No Acquirement of Good Will in Purchase of Alien Property

Among the alien-owned property sold by the Alien Property Custodian during the war was that of the Orenstein-Koppel A. G., of Berlin, at Koppel, Pa., engaged in the manufacture of industrial transportation equipment, which was purchased by the Industrial Car & Equipment Co. After the war the German corporation established offices at 50 Church St., New York, and sought to regain its former business. In an action by the purchaser to restrain it from resuming business in this country the Federal Court for the Southern District of New York has decided that the sale by the Alien Property Custodian does not prevent the original owners from again engaging in the same business in this country or from soliciting the patronage of former customers. In other words, the transfer of the property through the power of the Government did not carry with it the good-will of the business, no matter what representations were made at the time the property was sold.

Judge Hand said that if the German corporation had conveyed the property it would have implied that the good-will went with it, but that its transfer through the Alien Property Custodian is quite a different matter, and that the most the complainant can ask is that the German corporation shall not pretend to be doing business or manufacturing equipment at the Koppel plant or to be the complainant corporation. This decision that the involuntary sale of American good-will did not involve the implied covenant not to engage in business in this country, as in case of a voluntary conveyance, is the first one involving the right of a German company whose American property was sold by the Alien Property Custodian to resume business in the United States.

Efficiency in Handling Sulphur

In the Frash process of sulphur mining by underground fusion whereby superheated water is forced into the subterranean deposit where its heat melts the sulphur which thereupon is conveyed to the surface by an air-lift pump, the present practise is to solidify the sulphur [as illustrated on page 231 of May CHEMICAL AGE] in a huge block or pile, containing many thousand tons, and with the enclosing walls of the bin several hundred feet in length. Many weeks and frequently months elapse before this block of sulphur becomes solid throughout its entire mass.

To prepare this sulphur for shipment, blasting and much manual labor after the manner of stone quarrying, is necessary before the sulphur can be transferred by machinery to freight cars. Furthermore the slow rate of cooling, consequent upon the huge mass, requires the storage of great quantities in separate bins undergoing simultaneously filling and discharging. To save the time, labor and capital investment required in present practise and to get the sulphur in a form permitting convenient and quick handling Dr. Raymond F. Bacon, consulting chemist, 50 E. 41st St., New York, and Harold S. Davis, of the Mellon Institute of Industrial Research, Pittsburgh, Pa., have devised a method (U. S. Pat. No. 1,419,911) of solidifying sulphur which promises to contribute greatly to production efficiency in the industry. The method consists in solidifying the molten sulphur as rapidly as it is discharged from the well in a continuous manner and in a form requiring little if any preparation for handling.

The molten sulphur accumulated in a reservoir or tank is discharged therefrom through nozzles upon a belt conveyor subjected to a cooling air draft whereby cooled layers of sulphur successively are built up. The sulphur feeding nozzles are of a size sufficient to give a uniform coating of 0.025 to 0.050 inch in thickness and should be sufficiently far apart to allow each layer of sulphur to solidify before the next layer is superimposed. For a final block of sulphur one inch in thickness, this would require from 20 to 40 sulphur-feeding nozzles spaced at intervals of 2.5 to 5 feet for a belt 100 feet long. At the discharge end of the conveyor belt the mass of solidified sulphur is received on a platform and conveyed to storage for shipment. If it is desired to break up the sulphur discharged from the conveyor belt into smaller sizes, suitable crushing apparatus may be provided for that purpose.

The fact that the sulphur from the wells is immediately solidified tends to prevent discoloration from any oil which may be present in the mined sulphur. Sulphur containing oil, if held at a temperature of 130° C. for several days, turns very dark in color. It is not at all improbable that this colorization results during the solidification of the sulphur in accordance with the present vat or bin system of cooling, since large quantities of sulphur must in that system remain liquid for a very long time.

By the new method it is possible to build up a block of solid sulphur of any desired thickness while practically all the heat of solidification has been carried off each time through a thin layer of sulphur. In comparing two blocks of sulphur, one poured in a single layer, the other in a great many layers, the time saved in cooling in the latter case is notable. The total length of time required to cool a block of sulphur made in thin layers will be proportional only to the total thickness of the block. Since each layer of liquid sulphur fills up any cavities formed by shrinkage of the previous layer on cooling, the resulting block of sulphur is considerably denser than one of the same size poured in one layer.

Purifying Sodium Carbonate from Salines

In the manufacture of sodium carbonate and sodium bicarbonate from natural saline waters, there usually is present in the final product a small percentage of carbonaceous matter that gives the final product a grayish appearance; whereas the pure product is clear and white. Difficulty has been experienced in removing these carbonaceous matters. They of course can be removed by heating the mass up to oxidizing temperature in the atmosphere; but this involves the heating of the carbonates to their fusion point; which fused mass subsequently must be broken up again or treated or retreated in some process to produce the finely divided product which is desirable as a commercial product. Further than that, the heating of the mass to the fusion point, or above the fusion point, requires an excessive amount of fuel and usually produces an objectionable percentage of caustic soda whose presence in the carbonates is very objectionable, the trades requiring carbonates free from caustic soda.

Frank H. Merrill, Los Angeles, Cal., has devised a process (U. S. Pat. No. 1,419,463) applicable to the removal of carbonaceous and other oxidizable matters from carbonates without heating them to the fusion point and without change of physical state and at a temperature lower than is necessary to effect such oxidation by roasting in the presence of air. Resort is had to the use of sodium nitrate, in amount depending upon the amount of carbonaceous impurities present, which is mixed intimately with the salts to be decolorized and the mass heated to a temperature high enough to cause oxidation of carbanaceous matter by reaction with the sodium nitrate, but not to a temperature high enough to fuse the mass.

The process operates at any temperature from about 300° F. up to approximately the point of fusion of the carbonates. It is desirable to carry on the process at as low a temperature as is practicable, as thermal efficiency thereby is gained, and also because at lower temperatures there is less chance than there is at higher temperatures of over-heating locally any portion of the mass to a point above the fusion temperature. The fusion temperature of carbonate of sodium is about 1500° F.

By the reaction of oxidation the nitrate of soda is converted into carbonate of soda. If sodium carbonate or urao is being purified, the nitrate is converted into the same substance as one of the constituents of the mass. In the process now used for manufacturing sodium carbonate from saline waters, where the final carbonate is produced from an intermediate bicarbonate by heating, the purification process here described may be carried on simultaneously with this transformation step; the nitrate being mixed with the bicarbonate and then heated both for purposes of purification and transformation. In any case purification is effected at a much lower temperature than obtains with air oxidation. A much lower fuel consumption and much greater economy is the result.

Utilizing Trimmings of Composition Roofing

In the manufacture of felt or paper which is saturated with a waterproof binder such as asphalt, the trimmings and broken sections are now waste products. In the manufacture of strip shingles, the tabs cut out in the formation of the notches also are waste. These shingle or roofing elements generally consist of saturated felt, an asphalt coating of relatively high melting point, and a granular or grit surface on the coating. Lester Kirschbraun, of Evanston, Ill., has devised a process (U. S. Pat. No. 1,417,840) to recover and reuse the material of these trimmings, broken sheets or tabs.

In carrying out the process the tabs, which are generally 4 in. long by 1 in. wide, or the trimmings or broken parts, first cut to a similar size are put into a cylindrical screen seated in a tank so that the screen can be immersed in water. The screen is provided with agitating paddles, and itself revolves in the tank. The water in the tank is heated to nearly its boiling point. A charge of these tabs or the other wast products is put in the cylinder and subjected to the agitating treatment in the presence of the hot water, which detaches the grit from the asphalt coating; the grit falls through the screen and is recovered in the bottom of the tank. The temperature is not high enough to cause the coating to melt and detach itself from the felt base nor will the saturant be removed from the fibres.

The mass while still hot and freed from its grit is then placed in a disintegrator which consists of a heated cylindrical tank provided with rapidly revolving paddles or disintegrating knives mounted on a vertical shaft. The tank first is partly charged with an aqueous vehicle consisting of an emulsifying agent, as colloidal clay. Mr. Kirschbraun has found in some cases that 50 per cent of clay by weight to 50 per cent of water, will constitute a suitable starting medium. The contents of the tank are then heated to nearly the boiling point. The hot mass of fibre and bitumen then is gradually fed into the disintegrator and the contents subjected to agitation and heating which result in resolving the fibrous mass into a pulp and at the same time softens the asphalt. The fibre and bitumen are fed gradually through the disintegrator so as to produce a relatively non-adhesive emulsion in which the water is in the external phase. This operation may be carried on continuously by feeding in fresh material and withdrawing the more or less emulsified composition.

The pulpy mass thus produced may be cooled and then moulded by hydraulic pressure into articles such as buckets, conduits, mats, insulators, shoe elements and many other waterproof materials. If desired, the pulp may be formed into waterproof sheets to be used as roofings, floorings, wall boards, or other waterproof coverings. The articles so produced are dried and if desired, repressed. The pulpy mass before being formed into the desired shape may have added to it sawdust, cork, various fibres or additional asphalt in emulsified form.

Glycerol-Polybasic Acid Resins

It has been known for a number of years that resinous bodies are formed on beating together, under suitable conditions, a polyhydric alcohol, as glycerol or glycol, and one or more polybasic organic acids as succinic, malic, maleic, fumaric, citric, malomalic, or tartaric acid, but the products hitherto made by this method have been unsuited for many uses, such as molded or impregnated electrical insulation, varnishes and lacquers, by reason of their lack of resistance to water. After only a few minutes contact with water, most of them show signs of being attacked; the surface becomes dull and white, while if the water contact continues, the entire resin becomes soft and crumbly, finally losing its shape altogether. This action is more rapid with hot water, particularly boiling water. The uses to which these materials can be put are reduced in number by this lack of resistance to water.

Most of these resinous condensation products are, or can be, made from glycerol and phthalic anhydride, with or without the addition of the polybasic aliphatic acids already mentioned.

The necessity of adding other acids arises from the well-known fact that such glycerol products made from phthalic anhydride alone are too brittle for many uses; but the increase of mechanical strength by this means is generally accompanied by a sacrifice of resistance to water. These resins may be made inert to water by proper heat treatment. There are three classes of these condensation products:

Class A.—Initial condensation product; soluble in acetone; fusible; melting point seldom exceeds 120° C; not resistant to cold water; passes on further heating into a resin of Class B.

Class B.—Intermediate condensation product; insoluble in acetone; infusible; can be molded under heat and pressure; not resistant to cold water; passes on suitable heat treatment into a resin of Class C.

Class C.—Final condensation product; insoluble in acetone; infusible; can be molded under heat and pressure; resistant to cold water and to boiling water.

The methods of preparation of these three classes of resins may be briefly described as follows: A polybasic alcohol, such as glycerol or glycol, is heated with a polybasic aromatic acid, such as phthalic, diphenic, 1.8 naphthalic, or with various benzoyl-benzoic acids such as chlor-benzoyl-benzoic, methyl-benzoyl-benzoic acid, or with a mixture of one or more of these acids. A polybasic aliphatic acid, such as succinic, tartaric, malic, maleic, citric, malomalic, etc., may be substituted wholly or in part for the aromatic acid, and the heating is continued for several hours at a temperature perferably below 200° C. until the product loses its stickiness but still possesses the characteristics above set forth for Class A resins. For Class B resins the heating is continued for several hours, preferably at a temperature below 135° C. to prevent frothing, until the product becomes infusible and possesses the characteristics of Class B resins. In order to produce Class C resins, the product of Class B may be further heated with slow increase of temperature for a long period (24 hours or more) at a temperature as high as 250° C., the temperature being permitted to rise slowly at first.

Louis Weisberg has discovered (Pat. No. 1,413,415) that when any of the three classes of resins above is compounded with a suitable proportion of shellac, the resulting product may be used for many of the purposes for which shellac is commonly used without impairing the product, as do many of the gums commonly used to replace shellac in whole or in part. For example, when one of the soluble resins is employed, the product or composition may be used either as a varnish or as a molding composition. When an insoluble resin is employed the product is useful as a molding composition. Mr. Weisberg found that in using resins of Class A or Class B, the water-resisting quality of the molded composition as a whole is excellent, provided that the weight of resin does not materially exceed the weight of the shellac.

Various methods of mixing the resin and shellac may be employed. When the resin is soluble, it and the shellac are most simply mixed by dissolving them in any suitable solvent, such as acetone, alcohol, or ethyl acetate. If the mixture is to be used as a varnish, the solvent need not be evaporated. When the resin is fusible the two substances may be melted and thoroughly mixed in the molten condition, but this method is not always a convenient one to carry out. A useful method is to grind each material separately to a fine powder, and then mix them thoroughly by mechanical means. The product obtained in this way is suitable for some hot molding processes. For many purposes, however, it is preferable to grind the two materials separately, moisten each separately with acetone, alcohol or ethyl acetate, and mix them in this moistened condition in a dough-mixing machine or between mixing rolls. This procedure is especially adapted to resins of Class A and Class B. The method of mixing will in general be adapted to fit best with the purpose for which the material is to be employed.

All of these mixtures may contain suitable fillers, such as asbestos, cotton, wood pulp, talc, powdered stone, and other inert powdery materials, as well as the shellac and above-mentioned resins, when desirable, and the amount of shellac present is preferably at least as great as that of such resin. The mixtures containing shellac mold more quickly than do the resins themselves, have no tendency to stick in the mold, and the molding process does not require to be followed by a heat treatment. The products containing not less than the specified amount of shellac are substantially equal to shellac in water resistance, while in mechanical strength and dielectric properties they may even be superior to shellac.

Carbon Black Production

Use of natural gas for carbon black manufacture by methods that are wasteful of the potentialities of this resource has impelled legislation particularly in Louisiana that will make necessary greater efficiency in methods of production of this very essential commodity. Practically all of the carbon black or lamp black of commerce is now prepared by burning natural gas or other hydrocarbon or related carbonaceous fuel with an insufficient supply of air, the flame being chilled by impinging upon a cool surface on which the free carbon resulting from the imperfect combustion is deposited. The actual yield of lamp black by this process is low as compared with the mass of carbon in the fuel burned. It further is recognized that for the production of lamp black of the highest grade suitable for paints having great covering power, the yield must be kept well below the maximum yield obtainable by the ordinary process.

Dr. Warren K. Lewis, professor of chemical engineering, Massachusetts Institute of Technology, has found that it is possible largely to increase the yield of carbon black now obtained in the combustion of a hydrocarbon gas and at the same time to effect an improvement in the quality of the carbon black from the standpoint of fineness or covering power, by a modification of the conditions under which the actual combustion occurs. Such modification consists in causing the combustion to take place in what may be described as a dilute gaseous solution of hydrocarbon and oxygen; that is, instead of admixing with the natural gas oxygen and nitrogen in the proportions existing in the atmosphere, the percentage of oxygen being somewhat less than that required for complete combustion of the natural gas there should be present a relatively large diluting volume of an inert gas such, for example, as combustion gases obtained from the combustion of natural gas, or any other hydrocarbon fuel. This diluting inert gas should preferably be admixed both with the natural gas and with the air, in order to insure a completely homogeneous atmosphere in which the combustion takes place.

In carrying out the process (U. S. Pat. No. 1,418,811, assigned to the Goodyear Tire & Rubber Co.) natural gas is diluted with 1-2 volumes of combustion gas, which may be the gas obtained from the combustion of the natural gas itself in the process of manufacturing carbon black, or may be obtained from any other source. The air similarly before admixture in the combustion chamber is likewise diluted with 1-2 volumes of combustion gas. Since natural gas requires approximately ten times its own volume of air for combustion, the total quantity of diluting combustion gas may be from 14 to 25 times the volume of natural gas. Thus the total proportional quantity of diluting combustion gas may be from 15 to 20 volumes, based on the volume of natural gas.

One of the major advantages accruing from this invention is the flexibility in control of plant operations which results therefrom. By variation of the amount of diluen gas employed, combined with variation in temperature and amount of cooling water and the like, it is possible either to secure a much larger yield of black of a quality equal to that at present obtained without sacrificing the yield, or to combine these two advantages. This makes possible wide modification of product to meet market conditions without change in plant design.

Purification of Anthraquinone

In the production of anthraquinone by oxidizing anthracene with a solution of chromic acid such impurities as are admixed with the anthracene are subjected to the same oxidizing action as is the anthracene itself. As a result the anthraquinone produced, after dissolving out the constituents which are soluble in water or in the acid solution, contain various impurities. Harry F. Lewis, of the Buffalo plant of the National Aniline & Chemical Co., has found (U. S. Pat. No. 1,140,198) that the purity of the product can be increased materially by extracting the impure anthracene with monochlorbenzol which has a selective solvent action whereby the impurities or certain of them are dissolved with only slight solvent action upon anthraquinone itself. In this respect monochlorbenzol is claimed to be typical of the properties of the halogen derivatives of the simple aromatic and aliphatic hydrocarbons.

In carrying out the process 100 parts of crude anthraquinone are heated with 1,000 parts of chlorbenzol at a suitable temperature, with agitation, for about 30 minutes; the resulting solution is then filtered from the undissolved anthraquinone and insoluble impurities. The chlorbenzol solution obtained contains soluble impurities and may have a deep red color, while the anthraquinone remaining is lightened in color and materially improved in purity. The anthraquinone and insoluble impurities are washed on the filter with a further amount of solvent and the wash liquor or solvent can be returned to the solution tank for use in the extraction of further amounts of impurities from the next charge in the further carrying out of the process. The filtering operation is advantageously carried out in a closed system, so that the solution can be passed from the kettle to the filter press without loss of the solvent by evaporation. The filtrate may advantageously be collected in a kettle suitable for use as a still for the recovery of the solvent and of the dissolved impurities. The filter cake produced can be freed from its residual solvent by steam distillation.

Electrolytic Reduction of Metals from Fused Salts

Difficulty has been encountered in the electrolytic reduction of metals from baths of their fused salts, due, in large measure, to the fused electrolyte containing occluded or dissolved gases. These materially interfered with the deposition of metal, causing it to be non-adherent and porous. Electrical efficiency also is greatly reduced by reason of the liberation of such gases, necessitating a higher potential to conduct the electrolysis, giving rise to local currents, and interposing bubbles of gas to the flow of current, thus increasing the resistance of the cell. Electrolytes in the fused state and even at high temperatures often retain quantities of gases in solution with considerable tenacity. These retained gases are liberated during the decomposition of the salt by the electric current and constitute a source of disturbances, as stated, which are particularly troublesome at the cathode where the deposition of metal takes place, interfering with the formation of a dense coherent product.

Porter H. Brace, Wilkinsburg, Pa., has found that, by adding to the electrolyte a small quantity of a material which is capable of causing dissolved or occluded gases to be released or chemically fixed, such gases are readily removed. He adds a small quantity of an active metal to the fused electrolyte previous to electrolyzing it, with the result that the dissolved and occluded gases are removed, allowing the electrolysis to proceed quietly and uniformly, giving a product of greater purity, density and coherence than formerly could be produced. Metallic calcium is generally prepared by electrolyzing anhydrous, fused calcium chloride, usually with the addition of other fused salts. When the commercial anhydrous chloride is fused and immediately electrolyzed, considerable quantities of gases are given off, particularly at the cathode, making it rather difficult to secure a good deposit.

In applying his method to such an electrolyte, Mr. Brace fuses the commercial anhydrous calcium chloride, heating it to a temperature slightly above the melting point, and adds a small quantity of metallic calcium, stirring the same into the molten mass while allowing the latter to cool and solidify. During the addition and stirring of the calcium, a reaction occurs whereby the dissolved and occluded gases are released from the salt and removed. In some cases, it is desirable to effect a further removal of gases and this is accomplished by again melting the cooled and solidified anhydrous chloride obtained as described, adding a further small quantity of metallic calcium and stirring the molten mass, while allowing the same to cool until the mass becomes pasty and solidifies. The total quantity of metallic calcium necessary to produce purification of the salt is generally less than one part in 500 and a small excess of added calcium does not appear to be detrimental.

The chloride is generally fused again before it has cooled down below 400° C. and is then cast into molds. The ingots so produced are translucent, white, and perfectly sound, and show a well developed crystalline structure when fractured, whereas, without the above treatment, the solidified electrolyte is found to be full of blow holes and cavities. The ingots so produced are usually melted down and electrolyzed, the electrolysis proceeding quietly and uniformly without the evolution of gases or disturbances at the cathode. Mr. Brace sometimes omits the casting of the electrolyte into molds and simply fuses the treated salt and electrolyzes immediately.

The nature of the action of the degasifying agent has not yet been definitely determined, but is believed that it is at least partly a chemical action whereby occluded gases or vapors are rendered inactive by reason of their combination with the degasifying agent, forming a stable compound. This process may be applied to electrolytes other than calcium chloride; and metals other than calcium, which are chemically active, to release gases contained in fused electrolytes, may be employed. For instance, metallic sodium or other alkali or alkali earth metals may be used, but calcium is believed to be the most suitable on account of its low volatility and great activity at the high temperature generally used in fused electrolyte electrolysis.

Uses for Phenanthrene

In the working of certain distillates of coal tar and coal tar pitch, there is obtained by a carefully controlled process a solid product of characteristic composition and properties and of phenanthrene-content running from 75 per cent and lower to 90 per cent. Phenanthrene is an isomer of anthracene and crystallizes in colorless, lustrous plates melting at 90° and boiling at 340° C. and resembles anthracene in its reactions. The phenathrene distillate referred to varies in color from a light yellow brown to a snow white product. It is non-saponifiable and is soluble in such common solvents as benzol, coal tar naphthas, etc. Its properties adapt it admirably for use in admixture with rubber, viz., high dielectric properties which persist in the vulcanized article, and of importance where electrical insulation is a consideration; low specific gravity (1.06-108 at 15.5° C.), which reduces the volume cost of vulcanized rubber products; its wax-like properties make it a substitute for waxes in compositions where their addition is desirable; its light color makes it especially valuable in many vulcanized products inasmuch as it imparts no discoloration.

A Composite Catalyst

In the oxidation of ammonia to oxides of nitrogen it has been the commercial practice to make use of platinum as a catalyst, the platinum being commonly employed in the form of wire gauze or net. Attempts to replace platinum by other catalysts have not been commercially successful, and platinum has accordingly been used almost exclusively as the catalyst in the conversion of ammonia to oxides of nitrogen. Dr. Chas. H. MacDowell, H. H. Myers and W. B. Pattison, of the Armour Fertilizer Works (U. S. Pats. 1,420,201-3) have found that results comparable to those obtainable with platinum can be attained by subjecting a mixture of the ammonia and of the oxidizing gas to the action of vanadium oxide or oxides under proper working conditions.

In the contact or catalytic method of producing sulfur trioxide, and sulfuric acid, numerous catalysts or contact substances have been proposed. However, only platinum and iron oxide heretofore have been found commercially practicable. The former, despite its cost, is the most successful and widely used catalytic material, for the reason that it is possible to produce practically quantitative yields with it and, with proper precautions, its life as a catalyst is indefinitely long. Iron oxide, as a catalyst, is generally used in the form of iron pyrite cinder and, as such, is a by-product of the complete process, being produced when iron pyrites are burned to generate the necessary sulfur dioxide gas. Since the yields obtainable with iron oxide are comparatively low, it is practically always used in conjunction with a chamber system for producing sulfuric acid.

The possibilities of using certain vanadium compounds as catalytic agents have long been recognized, but this use has heretofore been very largely regarded in the light of an interesting scientific phenomenon, and little, if any, effort has been made to utilize effectively this property of vanadium compounds. The composite catalyst is made up of highly porous alumina serving as the body, obtained by the calcination of alunite or from other sources of aluminum, and vanadium oxide, Va_2O_5, the main catalytic agent, which is diffused through or impregnates the body. Both the alumina and the vanadium oxide contribute to the catalyzing effect, the vanadium oxide probably in the greater degree. Thus, for example, a satisfactory catalyst can be prepared by mixing 10 parts of ammonium vanadate very intimately with 100 parts of alumina obtained by the calcination and extraction of alunite, the mixture being moistened just enough to permit of molding and then briquetted into the desired shape. These briquettes are first air dried, and may then be introduced into the catalytic chamber and brought to the proper temperature to decompose the ammonium vanadate, preliminary to the maintenance of conditions favorable to catalysis, either of NH_3 or SO_2.

Sulphur Trioxide in Liquid SO_2 As a Sulphonating Agent

The excellence of sulphur trioxide as a sulphonating agent, is due first to the fact that it is very active chemically, much more so from the standpoint of sulphonation than sulphuric acid or any other sulphur compound, and second because it sulphonates by direct addition without the formation of water. Its greatest activity enables a sulphonation to proceed with less excess acid and without the employment of very high temperatures which would tend to cause decomposition. By preventing the formation of water, the well-known effect of this substance in preventing isomeric rearrangement is obviated. Armin R. Grob and Carleton C. Adams of the du Pont organization (U. S. Pat. No. 1,422,564), have found that liquid SO_2 is an excellent medium in which to effect sulphonating reactions in that it permits the use of SO_3 as a sulphonating agent without disadvantage of appreciable losses by side reactions, such as charring, oxidation and sulphone formation.

Sulphur trioxide when used undiluted often acts too vigorously, making the reaction difficult to control and causing a greater degree of sulphonation than that desired. It is usually diluted with sulphuric acid, but this makes a strong dehydrating mixture which favors decomposition, especially when oxygen is present in the compound, and also promotes the formation of sulphones. By diluting the sulphur trioxide with liquid sulphur dioxide, the action of the former can be made less vigorous and the reaction more easily controlled. The presence of SO_2, a strong reducing agent, lessens oxidation, minimizes dehydration, and less decomposition and sulphone formation are encountered.

This process of sulphonation as applied to the mono-sulphonation of benzene is as follows: Sulphur dioxide gas is liquefied in the usual way and the liquid allowed to flow into an evacuated vessel cooled to —10° C. An equal volume of benzene is then dissolved in the sulphur dioxide and the mass agitated by a stirrer revolving in a tight stuffing box or by revolving the closed vessel. A slight excess of liquid sulphur trioxide from the distillation of oleum (fuming sulphuric acid) is added to a second similarly designed, cooled, evacuated vessel. An equal volume of liquid SO_2 is then added to the second vessel and the mixture well agitated, keeping the temperature at about 0° C. The SO_3 solution is then allowed to flow slowly with agitation into the benzene solution, keeping the mixture at about 0° C. The temperature is then allowed to rise about 20° C. and preferably to about 30° C., the apparatus being tightly closed and the mass agitated for 2 or 3 hours. Heat is finally applied at the end of the reaction and the sulphur dioxide distilled back into the first chamber where it can be used for a second preparation. The benzene monosulphonate and excess sulphur trioxide is left as a thick residue.

The process outlined above is of quite general application and may be used for the sulphonation of naphthalene, anthracene, anthraquinone, and their derivatives, and various other aromatic compounds. The temperatures and pressures may vary widely, depending to some extent upon the particular compound to be sulphonated, it being desirable, of course, that the relation of temperature to pressure be such as will cause the sulphur dioxide to remain in the liquid condition. The temperature at which the reagents are brought together is preferably between —15 and +15° C.

Tung Oil to Waterproof Paper

Tung oil, or China-wool oil, may be converted by suitable heat treatment into a rubbery gelatinous condition in which it is insoluble in all ordinary solvents. Earle T. Oakes, of the National Biscuit Co., New York, has found that when paper or cardboard is impregnated with this gelatinized tung oil it becomes not only moisture-proof but also grease-proof. Paper or cardboard impregnated or coated with this product is desirable material for use as a container for food products. The tung oil may be gelatinized by heating to approximately 250° C. for about nine to twelve minutes. The product also may be formed by heating to about 100° C. for 12-14 hours. Application of the higher temperature is preferable, not only because of saving in time but also because a more uniform product is produced and there is less oxidation, as is apt to be the case when the lower temperature for the longer time is employed.

The insolubility of the gelatinized product militates against its use as a saturant in the form of a solution; and the gelatinization of the oil after saturation can be done only at the sacrifice of charring the impregnated paper. Mr. Oakes (U. S. Pat. No. 1,411,371) overcomes these difficulties by reducing the gelatinized oil to a colloidal form in a vehicle which may comprise such substances as solvent naphtha, turpentine, ethyl and methyl alcohols, carbon tetrachloride, ether and acetone. These liquids, being solvents for gums and resins, permit their addition to impart strength and body to the composition, after the expulsion of the solvent.

The application of the liquid vehicle to the finely divided gelatinized tung oil causes the latter to swell to 4-5 times its original bulk, in which condition it remains in suspension for a considerable time, apparently in a state of colloidal solution. The application of the liquid vehicle to the tung oil may be during gelatinization or subsequent thereto and while in process of comminution, and is found to make the product less sticky and gummy and more easily ground.

If added bodies such as the common gums are thought desirable for incorporation, they may be added to the tung oil either before or after gelatinizing, preferably before. Among the substances which may be added effectively are shellac, resin, copal, kauri, sandarac, etc. If paper or the like is to be coated or impregnated with the material, the article may be dipped or brushed with the fluid material. Thus paper may be run through a bath of the composition and subsequently through squeeze rolls in the usual way. After the paper or fibrous material has been coated or impregnated, the material is dried to drive off the solvent or liquid carrier, the resulting product having the desirable properties mentioned.

Phosphoric Acid Production in the Fuel-Fired Furnace

It is well known that phosphorus can be practically completely expelled by fusion heating of a properly proportioned mixture of phosphatic material. The reaction which takes place may be summarized by the equation:

$$Ca_3(PO_4)_2+3SiO_2+5C=3CaSiO_3+2P+5\,CO$$

It has generally been believed that a practical liberation of P_2O_5 by this reaction could be obtained only at the temperature at which a fluid melt is obtained. In confirming the fact E. W. Guernsey and J. Y. Yee, Washington, D. C., discovered that, contrary to current belief, phosphorus may be practically completely expelled from an intimate mixture in proper proportions of phosphate rock, sand and coal at temperatures considerably below those heretofore employed, provided the temperature is maintained just under this point of fusion of the mass.

The temperature of the fluid melt of the raw materials of phosphoric acid production can be attained easily only in the electric furnace. Use of the electric current for smelting purposes, however, is very expensive; with electric power at $.005 per K. W. H. the cost of electricity for heating is more than 50 per cent of the total cost of the phosphoric acid produced. A further disadvantage and expense connected with the use of the electric furnace are the lining replacement charges due to high temperatures employed, high installation and high-grade labor costs.

The temperature found by Messrs. Guernsey and Yee to be commercially practicable without the aid of the electric current depends on the composition of the charge, but is in the neighborhood of 1300° C. which can be attained in relatively inexpensive and simply and cheaply operated fuel-fired furnaces under conditions sufficiently non-oxidizing to prevent the burning of the carbon in the charge before it can perform its function of reducing calcium phosphate. An internally-fired rotary kiln heated with a non-oxidizing flame meets these requirements. When this type of furnace is used it is preferred to briquette the charge in order to prevent the dusting of the powder charge and in order to furnish an additional safeguard against the burning out of the carbon in the charge.

In carrying out the process the ingredients of the charge, i. e., phosphate rock, sand and coal, are mixed in such proportions that the combined lime and silica are in the molecular ratio of 1:1 and carbon is present in at least 50 per cent. excess of that required by the above equation. This mixed charge is briquetted and the briquets fed into an internally-fired kiln wherein fuel and air are proportioned to maintain a reducing atmosphere and the heat so regulated that the temperature is brought only to incipient clinkering or slightly thereunder. Under these conditions practically all of the phosphorus is evolved in the elementary state. The duration of the heating necessary to secure complete expulsion of the P_2O_5 depends on the fineness and intimacy of mixing of the materials, on the physical structure of the phosphate rock, on the exact composition of the charge, etc. For an ordinary Florida or Tennessee phosphate rock the time of heating need not exceed one hour at the most if the materials are ground to a fineness under 100-mesh. The gases from the kiln, containing the expelled phosphorus may be burned under boilers or other heat conserving devices. The oxides of phosphorus contained in the gases from the burners may be collected in any suitable manner as for instance by a Cottrell precipitator or they may be absorbed in any well known and usual manner.

Making Antimony Sulphide

Antimonic sulphide (Sb_2S_5) or a mixture of this pentasulphide with antimonous sulphide (Sb_2S_3) is used for vulcanizing and imparting a red color to rubber. The pentasulphide is an orange red powder readily soluble in alkaline sulphide and decomposes on heating into the trisulphide and sulphur. The mixture of penta- and trisulphides varies in color from yellow to orange red according to the proportion of the former sulphide present, whereas the natural sulphide of antimony, occurring as the mineral stibnite, is black, consisting especially of the trisulphide (Sb_2S_3). Arthur L. Stark, Elyria, Ohio, has patented a process for the production of this mixture of sulphides from stibnite, which he describes (U. S. Pats. No. 1,414,836-7) as follows:

Relatively equal parts of quick lime, sulphur and stibnite (the proportions depending, however, upon the purity of the stibnite) are reduced to an impalpable powder, thoroughly mixed and gradually moistened with water to a pasty consistency. To obtain the water-soluble double sulphide, the mass mixed with more water is transferred to an autoclave, where it is heated under a pressure of 60-80 lbs. to a temperature of 145-155° C. Injected steam serves not only to heat but to agitate the charge, which treatment is continued until the ingredients are converted into the water-soluble double antimony-calcium sulphide ($Sb_2S_3Ca_2S_4$). Mr. Stark claims that a more complete absorption of the raw materials, i. e., of the stibnite, sulphur and quick lime, is secured and that very little of such material is lost in the form of sludge, and that the conversion takes place very rapidly. By thus requiring a relatively small amount of material to be in process, a marked economy is effected, at the same time a superior product is formed. The compounds capable of forming a soluble double salt with antimony embrace hydrates and sulphides of the alkaline earth and alkali metals.

The solution obtained by autoclaving is then treated with sulphuric acid preferably, whereupon a precipitate consisting chiefly of antimony pentasulphide is formed in a fine state of subdivision. Where the alkaline earth metals are used, the corresponding sulphate is formed along with the antimony pentasulphide, the latter apparently being precipitated onto the former. This compound is known in the trade as antimony sulphuret in contradistinction to the natural or fused sulphide

Personal Items

Gerard Swope, M. I. T., '95, has been elected president of the General Electric Co., 120 Broadway, New York.

* * *

Frederick R. Sites, M.I.T. '99, has been appointed private secretary to Elbert H. Gary, chairman, board of directors, U. S. Steel Corporation.

* * *

J. M. Gillett, formerly with the Goodyear Tire & Rubber Co., Akron, Ohio., is now chemical engineer, Lamberson Japanning Co., Chicago, Ill.

* * *

A. A. Holmes, formerly of E. B. Badger & Sons Co., Boston, Mass., is now sales manager, American Trona Corp., 233 Broadway, New York.

* * *

Bailey Tremper, formerly chemist, Superior Portland Cement Co., Concrete, Wash., has been appointed engineer of tests, Division of Highways, of that State.

* * *

H. J. Robertson, formerly chief chemist, Western States Portland Cement Co., Independence, Kan., is now chief chemist, Pierce Oil Corpn., Sand Spring, Okla.

* * *

Dr. T. F. Aschman, chemist, Pennsylvania Bureau of Foods, has been appointed chairman of the board of chemists of the Bureau to succeed Dr. William Frear, deceased.

* * *

C. W. Crowell, formerly chemist, California Hawaiian Sugar Refining Co., Crockett, Calif., is now plant superintendent, Rochester Germicide Co., Rochester, N. Y.

* * *

W. G. Current, formerly assistant superintendent, Buckeye Rubber Products Co., Willoughby, Ohio, is now production superintendent, Thermoid Rubber Co., Trenton, N. J.

* * *

G. G. Crewson, formerly plant manager, Refractory Products Corp., Index, Va., is now on the engineering staff of the Buffalo plant of the National Aniline & Chemical Co., Inc.

* * *

E. A. Schiebe, of Bausch & Lomb Optical Co., Rochester, N. Y., has been appointed a member of the executive committee of the National Association of Purchasing Agents.

* * *

H. A. Noyes, formerly industrial fellow of Mellon Institute of Industrial Research, Pittsburgh, Pa., is now research chemist for the Michigan Department of Agriculture, Lansing, Mich.

* * *

J. F. Smith, of the research staff at the Buffalo plant, National Aniline & Chemical Co., will take charge of the research and information service of the Commercial Solvents Corp., Terra Haute, Ind.

* * *

James A. Stader, 1906 chemical engineer, University of Michigan, has been appointed head of the mineral section of the iron and steel division of the Bureau of Foreign and Domestic Commerce.

* * *

Arthur J. Hopkins, of the department of chemistry, Amherst College, has started on a tour of eleven months through Spain, Italy and Egypt, where, it is said, he will search for traces of alchemy.

William O. Hadley, formerly chief chemist, Chemical Research Co., Lynn, Mass., is now associated in the same capacity with Rubber & Cements, Inc., Chicago, Ill.

* * *

Marcus M. Marks, former president Borough of Manhattan, and his brother have sold their interest in Morris Herrmann & Co., dry color makers, Newark, N. J., to Edward Blum, a former silk manufacturer.

* * *

E. O. Reed, assistant chemist, leather and paper laboratory, Bureau of Chemistry, U. S. Dept. of Agriculture, has been appointed chief, testing section, U. S. Government Printing Office, Washington, D. C.

* * *

William J. Grier, of the North British & Mercantile Insurance Co., Ltd., of New York, will deliver two lectures on "Chemical Fire Hazards" before the Senior Class of the Insurance Institute of America on Feb. 15 and March 1, 1923.

* * *

T. T. Reed, chief, Information Service, U. S. Bureau of Mines, sailed for Rio Janeiro on Aug. 15, where he will attend the International Congress of Engineering as the representative of the American Institute of Mining and Metallurgical Engineers.

* * *

H. Gardner McKerrow, for the past three years advertising manager, National Aniline & Chemical Co., Inc., has resigned, and will engage in independent business in New York as an advertising and merchandizing consultant, specializing in textile and chemical matters.

* * *

Earl B. Millard, professor of materials of engineering, and Harrison W. Hayward, associate professor of theoretical chemistry, Massachusetts Institute of Technology, have been appointed assistant directors of the Division of Industrial Cooperation and Research.

* * *

O. P. Hood, U. S. Bureau of Mines, is absent on a three months' study in Europe of new developments in lignite utilization and low-temperature carbonization of coal, for the purpose of applying the information to studies in lignite and fuel utilizaiton now being conducted under his direction by the Bureau of Mines.

* * *

Prof. E. A. Hersam, University of California, has been appointed metallurgical chemist by the Bureau of Mines to represent it in the investigation of milling problems affecting the metallurgical industry of the United States, which will be undertaken at the Massachusetts Institute of Technology in cooperaiton with G. H. Clevenger and Charles E. Locke.

* * *

Mengo L. Morgenthau, 431 Hudson St., New York, Class of 1874 of the College of the City of New York, has presented to Prof. W. L. Estabrooke for use at the College of the City of New York, especially in connection with Dr. Estabrooke's courses in inorganic chemistry, a collection of over fifteen hundred minerals valued at $25,000. The collection is beautifully housed in a case 17 ft. x 8 ft. x 1½ ft. and electrically lighted. It has been placed in the entrance hall of the Chemistry Building, now called Baskerville Hall in honor of the late Charles Baskerville, director of the Department of Chemistry, 1904-1922.

Industrial Notes

The Ford Motor Co., Highland Park, Mich., will construct a new one-story laboratory and mechanical research plant, 200x800 ft., estimated to cost about $500,000, including equipment. It will replace 13 temporary buildings of this character erected during the war.

* * *

The Maurice Chemical Co., 1427 Washington Boulevard, Baltimore, Md., recently organized, will operate a plant to manufacture refractory and high temperature cements for furnace and other service. A list of equipment is being arranged. D. E. Collins is president.

* * *

The Anaheim Sugar Co., Anaheim, Calif., is installing equipment, designed and built by the Pacific Copper & Brass Works, Los Angeles, Calif., for the distillation of alcohol from beet molasses, which will have a daily capacity of 25 tons of molasses. Carbonic acid gas, a by-product of the fermentation, also will be recovered and marketed.

* * *

Canadian Salt Co., Ltd., in offering $140,000 7 per cent. mortgage bonds, states its capacity for the production of salt exceeds the combined capacity of all other Canadian salt plants, and for the past four years it has produced over 55 per cent. of the caustic soda and bleaching powder used in Canada. Its plants are located at Windsor and Sandwich, Ontario.

* * *

The Pacific Coast Borax Co., San Francisco, Calif., has acquired the property of the Chandler Shipbuilding Co. at San Pedro Harbor, Los Angeles, comprising about 10 acres, as a site for a new refinery to cost about $1,000,000, including machinery. The works will include a power house, machine shop and other mechanical buildings, and will require crushing, mixing, conveying machinery, etc.

* * *

Foamite Firefoam Co., 151 Fifth Ave., New York, and O. J. Childs Corporation, Utica, N. Y., have amalgamated as the Foamite-Childs Corporation, with executive offices at Utica, the latter member of the new organization having functioned for several years as the manufacturing division of the Foamite Firefoam Co.

* * *

The Johns-Manville Co., New York, manufacturer of asbestos and fireproofing products, has acquired the Bennett Martin mining properties at Thetford Mines, Que., and plans the early construction of a new plant at Asbestos, Que., to cost approximately $1,000,000, including machinery. It is expected to have the mill ready for operation by the end of the year.

* * *

Proctor & Schwartz, Inc., Phila., Pa., manufacturer of drying machinery, will absorb the Smith & Furbush Machine Co., of that city, manufacturer of textile machinery, in which the former has held a controlling interest for a number of years. The consolidated company will be capitalized at [illegible]. Plans are under way for [illegible] in the Proctor & Schwartz, Inc., plant [illegible] the Smith & Furbush plant [illegible] be removed and the present plant [illegible]. Walter [illegible] will be president of the [illegible] company, and Frank [illegible] secretary and treasurer.

Sulphur consumption is a good index of general business conditions in the chemical industry. The Freeport Texas Company's report for the first half of 1922 shows gross sales of $2,190,859, an increase of $584,496 over the same period in 1921, but increase of costs followed the increase of business to the degree that there was no increase of gross profits, in fact, a decrease in net profits from $210,946 for the first half of 1921 to $84,127 for the corresponding period of the present year. Present operations are at approximately 100 per cent of capacity and production is approximately 1,000 tons of sulphur a day. Contracts have been made for the bulk of next year's output, expected to amount to approximately 500,000 tons.

* * *

Air Reduction Sales Co., Inc., 342 Madison Ave., New York, has acquired sites and will begin at once the erection of additional plants at Milwaukee, Pittsburgh and Birmingham, Ala., for the manufacture of oxygen, acetylene, and oxyacetylene cutting and welding apparatus and supplies.

Facilities for producing oxygen from the air also will be enlarged in Buffalo and Minneapolis.

The completion of the new construction will bring the total number of the company's oxygen plants throughout the country up to 20, the acetylene plants to 11, and the calorene plants to 2. These are in addition to the air reduction apparatus plant in Jersey City, N. J., the recently acquired Davis-Bournonville apparatus plant, also in Jersey City, and the Ivanhoe, Va., plant of the National Carbide Corporation.

* * *

E. I. du Pont de Nemours & Co., since its group insurance plan was put into effect April 30, 1919, has paid to disabled employes and to beneficiaries of deceased employes a total of $420,114. The plan provides that all employes who have been with the company for six months or more are insured, at no cost to themselves, in amounts ranging from $1,000 to $1,500, depending on length of service. A provision was added to the plan in 1920 whereby, if an employe is totally and permanently disabled, prior to attaining the age of sixty years, payment of amount of insurance will be made. This is in addition to whatever benefits may accrue to the employe from the operation of workmen's compensation laws. It also protects the employe who may be totally and permanently disabled outside of working hours and whose case would, therefore, not be covered by the provisions of the workmen's compensation laws.

EQUIPMENT WANTED

Column still, Dephlegmator, Sulphonators. Give description, location and price. Robey Tank Works, 2513 South Robey St., Chicago, Ill.

CHEMICAL ENGINEER WANTED

Capable and experienced man wanted with experience in heat, temperature and moisture control in the [illegible] of [illegible] or food products and capable of [illegible] equipment and machinery. Reply giving full particulars, experience, references, etc., to Cereal, care of Chemical Age.

CHEMICAL
AGE
A CONSOLIDATION of THE CHEMICAL ENGINEER and CHEMICAL AGE
LLOYD LAMBORN, *Editor*

VOLUME 30 NEW YORK, SEPTEMBER, 1922 NUMBER 9

Political History, Economics and Future of Our Organic Chemical Industry

By H. Gardner McKerrow

THE dyestuff industry is still awaiting the final decision of Congress as to the kind and extent of protection it shall be accorded against foreign competition. By the time this appears in print it may have cause to feel that its future is safeguarded and assured, or it may be facing the future with a feeling of discouragement and apprehension. The principle of an embargo, so-called, against competitive foreign goods has been denied to it by both the House of Representatives and the Senate, and the method of protection adopted by Great Britain, France and Japan has not been accepted as being properly applicable to American conditions.

German Control in France, Italy and Japan

The French system could not, perhaps, be called an embargo, in that it consisted in the imposition of a tariff to equalize the difference between foreign and domestic costs—which has been increased since its first enactment—coupled with a proviso that importations of dye products must be sanctioned by the Ministry of Finance, in agreement with the Office of Chemical and Pharmaceutical Products. It was, therefore, more in the nature of a licensing provision rather than an embargo. It is necessary to speak of it however, in the past tense, for the Compagnie Nationale des Matières Colorantes has recently acknowledged that it has been compelled to acquire the patent processes and the technical aid of its principal foreign competitor, which means that an agreement has been effected whereby Germany has once more come into complete control of the French dyestuff industry. A similar arrangement has been made by the Italian dyestuff industry; it is reported that Japan also has negotiated a working agreement with German interests.

H. GARDNER McKERROW

It is interesting to note these successive deals as indicative of the determination of Germany to regain control of these interests and, having found that the temper of the world bids fair to keep her without bread in this respect, to be content with half a loaf.

Shore Leave for Chemical Sailors

After three years of tempestuous voyaging over the legislative seas and in spite of strenuous efforts on the part of its officers and crew, not always undertaken in perfect harmony or with evidences of good seamanship, the bark freighted with the hopes of the organic chemical industry of this country, came to within measurable distance of foundering almost within sight of her dock. At the last moment, however, a life-line was thrown to it from a comparatively unexpected source, and it is now riding the subsiding storm within sight of its haven and safety, though in a perilously leaky condition.

The Senate has voted, as an amendment to the provisions of the Fordney Bill on this schedule, that imported coal-tar products shall be subject to specific and ad valorem rates of duty far higher than anything asked for by the members of the dyestuff industry, and that the ad valorem duty shall be assessed, in the case of competitive goods, on the basis of American valuation. This constitutes a more effective embargo than anything which the advocates of protective legislation have had the temerity to suggest.

What will happen to this amendment in conference committee remains to be seen; it is possible that these rates of duty may be materially reduced, and that the method of administration may be changed. There is room for encouragement in the latter respect, however, in the fact that by conceding the method of American valuation on this schedule, the Senate is accepting the principle to which the House of Representatives has committed itself, and the House conferees are not, therefore, likely to demur at its adoption. That is where the matter stands at this writing, with the betting about even, and with the exhausted crew getting some needed rest, and restoring order to the disordered and almost dismantled vessel.

The Ship's Log

It is perhaps, of interest to analyze the position in which the industry found itself immediately prior to this unexpected development and to determine, if possible, what were the causes of the storm, to continue the allegory for a moment, with which the industry had to struggle so long.

Looking back over the three years since the Fall of 1919 one familiar with the course of events cannot fail to be struck by the fact that the industry has lost steadily, in spite of the publicity it has received, both in public appreciation and understanding, and in legislative support. At that time the Longworth Bill had been passed by the House of Representatives, carrying what seemed to be a satisfactory provision for licensing the importation of foreign dyestuffs. There was a majority in the Senate quite sufficient to pass the measure at any time it could be brought to a vote; and the only reason it was not brought to a vote was that, under the archaic rules of the Senate, any matter, even of great public interest and importance, may be talked to death by one or more Senators (unless the Senate as a whole votes to limit discussion, which is only done in cases of great emergency) who may have personal reasons for opposing its passage. It was the filibuster conducted by Senator Moses, of New Hampshire, and Senator Thomas, of Colorado, which prevented the enactment of this protective legislation to an industry born under the stress of conditions developed by the war, and which is of the most vital necessity to the industrial life of the country.

Back of it all stood President Wilson, who, in two public messages urged the necessity of its passage, and expressed his readiness to sign the bill as soon as it reached him.

Incidentally, among the supporting pleas in favor of the passage of the Longworth Bill were petitions indicating that probably seventy-five per cent., at least, of the color-using industries, notably the textile industry, which is by far the largest user of dyestuffs, were in favor of its adoption. That was the situation in the Fall of 1919. What was it in 1922 immediately prior to the aid given by Senator Bursum at the last moment?

The Longworth Bill having died a natural death with the last Congress, the dyestuffs legislation, in the form of an embargo against the importation of foreign dyestuffs, to be regulated and administered by the Tariff Commission, was embodied in the Fordney Tariff Bill, and in this form was rejected by the House, and stricken out of the bill.

It was reintroduced when the Bill went to the Senate, and thereafter pursued a varied and hectic course for many months before the Senate Finance Committee. Bitterly and vituperatively attacked by Senator Moses and Senator King, by certain textile interests whose vision was limited by the bindings of their own cost books, by the expected and perfectly natural antagonism of importers of dyestuffs, and by the accredited representatives of German interests, it swung back and forth between the prospect of possible success and ignominious failure for many months.

It was confused with other issues with which it had no, or but remote, relation, such as the President's demand for the return of the patents held by the Chemical Foundation, and was the victim of as thoroughly organized and ably conceived a campaign of propaganda —there is no other word for it—against the use and value of American dyes as was ever known. Ultimately, the Senate Finance Committee reported in favor of continuing the embargo under which the industry has been operating since the passage of the Emergency Tariff Act, for a period of one year, giving the President the right to continue it for another year if, in his judgment, existing conditions warranted it. The Senate, in Committee of the Whole, rejected this recommendation by a narrow margin, and opened the way for Senator Bursum's amendment which was adopted in the last hours of discussion of the Tariff Bill as a whole.

The Present Situation

The conclusion must be reached that, for some reason or other, the dyestuff industry has lost ground since 1919, and does not occupy the position in the public estimation and understanding that it did then. Whether this must be attributed to the effectiveness of its opponents, or whether it is due to inherent defects in itself and in the methods of its advocates, is, perhaps, a debatable question.

It is the writer's frank opinion that the Dyestuff Industry has no one but itself to blame for this situation. Its councils have been divided from the first; its actions have been furtive and timid throughout. Indecision and vacillation have marked the conduct of its defensive campaign, and no cohesion or co-ordination, at least not until very recently, has been evident in its efforts.

After the disappearance of the scores of small concerns making coal-tar dyes and other products, which were created by the exigencies of the war situation, and which, for the most part, had no economic right to existence, the industry settled down to a condition where it was dominated by two very large interests, several substantial secondary factors, and a number of small ones specializing, often very effectively, in certain dyes and intermediates. The secondary interests, for the most part, had other chemical activities in which they have been engaged for many years. Their incursion into the dyestuff field was brought about by the profitable market for dyes during and immediately after the close of the war.

Restricted as the field has become, as compared with that which existed in, say, 1918-19, there is even now a condition of over-production which makes the possibility of profitable operation remote, if not impossible. So long as this country was receiving a large share of the foreign trade of the world this condition was not markedly observable, but when, in 1921, Germany began to reach out for her former South American and Far East control, our foreign trade in dyes practically disappeared, as might have been expected.

It is probably gone forever, and those who are looking forward to a time when America can compete with Germany for the dye markets of the world are hugging a delusion; at all events so long as we continue to exist under the accepted American doctrine of protection. Apart from the fact that we do not have the instinct for foreign trade, and have practically no facilities for organizing it as it is organized by both the Germans and the British, it is extremely doubtful if we ever shall develop our dyestuff manufacturing systems to a point where our costs will compare favorably with German costs when normal conditions are restored in that country, as they will be some day.

The Two Dominating Factors

Of the two dominating factors in the industry, so large that together they probably supply 75 per cent. of all the dyestuffs used—it may be said that they have been actuated by exactly opposite policies. One has frankly taken part in the effort to secure proper recognition and protection for the industry. It has taken a front position on the firing line, and has received the brunt of the attack both in Congress and in the public press. It has been pilloried as a grasping monopoly bent on laying the color-using industries of the country under tribute, and intent only on exploiting the situation for its own profit.

The other factor has managed to keep under cover; its activities have been practically unknown, and have, in some cases even been credited by Congressional critics to its rival. It has refused to become identified with any of the movements and associations which were designed to consolidate and unify the industry, and it has pursued a policy of isolation and non-cooperation with all efforts which were planned to further the interests of those engaged in the manufacturing of dyestuffs and other coal tar products. What its ultimate object is in segregating itself from other American interests is not apparent—as yet.

The Small Concerns

The third factor—the small concerns specializing in one or two products, occupy a position which, at the present time, is not without its profitable advantages. They do not, for the most part, make their own raw materials, but they can secure these under present conditions at much lower costs than they could install plants to make them for themselves. Many intermediates necessary in making certain special classes of dyes are produced by the larger interests as by-products. They are obtained in the process of making something else, and under present price conditions can be purchased at figures which do not represent a manufacturing profit. There is thus afforded an opportunity for the small manufacturer to make a finished product, in many cases, of unquestioned excellence, and at a cost which the larger concerns, with their great overhead expense frequently find it difficult to meet.

Furthermore these small concerns do not, as a rule, market their own goods. They sell to the dealers who have so far taken all they can make; and the dealers, in spite of efforts to exterminate them, are still with us, and always will be.

Dyestuffs During the Depression

The collapse which overwhelmed all lines of business last year found the dyestuff industry in a particularly vulnerable state. The organizations which were built up during the strenuous war period, induced by a time of easily made profits to disregard the finer points of cost estimation, found themselves with domestic demand reduced to a minimum, with time contracts cancelled, and with a foreign business which disappeared almost overnight. A price-cutting campaign ensued, perhaps naturally, although one feels that it might have been avoided by men of larger vision and greater resourcefulness. And at the very time when the industry was being abused in Congress as extorting unheard of and unprecedented profits from the consuming trades, it was confronting a situation where it might fairly be said that the more dyestuffs were sold, the more money was lost.

When once an industry gets on the toboggan slide of price reduction, it is not easy, under any circumstances, to block the accelerating impetus; and it usually has to await the time when the demand increases and becomes so insistent that the situation automatically adjusts itself under the operation of the oldest of economic laws, supply and demand. But the dyestuff industry is denied the operation of even this most fundamental principle; it cannot raise its prices while the legislation pending before Congress is still unsettled and can still be affected by outside pressure. The opposition of the textile trades, already grievously disturbed because they cannot get dyes at pre-war prices, and oblivious of the fact that their own raw materials are not obtainable, as yet, at pre-war prices, would make such a protest at the prospect of an increase that Senator Bursum's none too tenacious life-line might be broken even now.

The Textile Interests

It is not easy to follow the thought processes of certain conspicuous members of the textile industry in their opposition to an adequate protection to the dyestuff industry. They are almost without exception high tariff men insofar as their own goods are concerned, and demand rates which as nearly as possible shall exclude foreign competition. They are not inconsistent in demanding this in view of the avowed fiscal policy of the country. But they are, apparently, blind to the probable fact that Germany's effort to get control once more of the dyestuff situation is not directed at that comparatively insignificant interest in itself, but that she has a much vaster aim in view, viz., the control of the textile interests of the world.

The Future

It is true that the war is over, and the world is sick of talk about Germany's system of espionage, political or commercial. That was all very well in 1917 and 1918, when the blood was hot, and when we were ready to believe any story of the efforts of her representatives in this country to impede the manufacture of supplies and munitions for the Allies, to blow up works which were engaged on war commodities, to plant bombs in coal shipments, etc., but now, in 1922, that is all forgotten. All we ask is to be allowed to pursue our industrial way as peaceably as possible, and without being troubled by prophecies of mischief to come and frightened by the spectre of Germany's commercial domination of the world of the future.

That is the way, too, they are talking in England, and but little patience is shown those few voices, crying, as Lord Roberts and General Wood cried, in the wilderness of material well-being and content. Both great industrial countries are being lulled back into sleep. Be sure that the siren song which is soothing them into futile slumber is the song of the Lorelei, and comes from the banks of the Rhine.

Germany today is impotent, both from an industrial and a military point of view; but does any thinking man believe she will remain so?

There are in that nation of sixty-six millions of people two great bodies of thought, quiescent, conciliatory and harmless now, but none the less virile and menacing: the one military; the other industrial. The military body comprising the aristocracy of former years, the so-called Junkers, and the officers of the former Kaiser, are dreaming of the restoration of the monarchy, and the re-establishment of their influence and privileges; that is a political question, and we can afford to let the politicians take care of it.

The commercial body, comprising great captains of finance and industry, whose plans were so near fruition in 1914 when the foolish haste of the military class brought them crashing down and impeded, but did not stop, their progress for a generation—this body knows exactly what it wants and is patiently laying its plans again for the peaceful penetration of the markets of the world. It has no patience with the Junker party; it looks upon it as a mischievous obstacle to the accomplishment of its own aims and ambitions.

And one of its ambitions is unquestionably to control the textile destinies of the civilized world. Great Britain and the United States control the two chief raw materials of textile manufacture, wool and cotton, and their factory systems are far greater and more varied and extensive than those of Germany—but they are dependent on dyes. Let the dye industry be destroyed in Great Britain and the United States; let it be within the power of Germany to dictate what dyes shall be at the disposition of these two industrial countries, and their textile supremacy is gone.

This view of the situation takes no cognizance of the incalculable importance to the industrial life of this country of the organic chemical industry as a whole, of which the dyestuff industry is a comparatively insignificant branch. It takes no cognizance of what a self-contained American organic chemical industry means in the production of high explosives and poison gases in the event of another war; and who is so optimistic as to believe that another war may not come?

It takes no cognizance of what an American organic chemical industry means in the production of those indispensable pharmaceuticals on which some of the most horrible and corroding of human ailments depend for alleviation and cure. The evidence in those cases is in; the testimony of responsible officers of the United States army and of reputable physicians is to be found in the record of the hearings before the Ways and Means Committee of the House of Representatives, and of the Senate Finance Committee during the past three years, and speaks "with no uncertain sound" of the matured and well-considered beliefs of those who are best fitted to know.

Properties of a Good Wood Preservative

A list of the various substances that have been used or suggested for preserving timber from decay would include a surprisingly large proportion of those known to industrial chemistry. By-products for which no use could be found have often taken their last stand as possible preservatives of wood. There have been sent to the U. S. Forest Products Laboratory for testing of their preservative qualities the condensed fumes of smelters, the waste liquors of pulp plants, the refuse of tanneries, the skimmed milk of creameries, and a wide assortment of compounds under trade names. Very few materials have been found to have value as wood preservatives. Most of them lack one or more of the following requirements:

To preserve wood against decay a substance must first of all be poisonous to wood destroying fungi. Decay in wood is not due to direct chemical action or action of the elements, but is always the result of the activity of these plants which feed on the wood and thus destroy it. To prevent fungous infection, the preservative must be able to penetrate the wood thoroughly enough to form a continuous exterior shell of poisonous treated wood deeper than any surface checks which are likely to develop, and to retain its toxicity, or poisoning power, under service conditions.

Safety in handling and use is another important consideration. A wood preservative must not be a dangerous poison to men and animals, a highly inflammable substance, nor a material injurious to wood. If it seriously corrodes iron, steel, or brass its use is limited because of its action on the treating equipment and on bolts and metal fastenings in contact with the wood in service. Color, odor and effect on paint are sometimes of considerable importance. Provided a preservative meets these requirements its cost, availability and uniformity will largely determine its usefulness.

There are materials of established protective value now on the market which are both cheap and plentiful. The standard wood preservatives in the United States are zinc chloride and coal-tar creosote. Their value has been established by many years' use of millions of railroad ties, poles, posts, paving blocks, mine timbers, and other wood treated with them. Search for new and better preservatives is constantly being made, but in the meantime the wood preserving industry has at its command these reliable materials.

The Work of Mellon Institute

The Mellon Institute of Industrial Research of the University of Pittsburgh has issued as the first number of its Bibliographic Series a bulletin which, in commemoration of the tenth anniversary of the establishment of the Industrial Fellowship System at the University of Pittsburgh, appropriately sets forth its published contribution to scientific and technical literature from its inauguration, March 1, 1911, to January 1, 1922. These contributions embrace books, bulletins, journal articles and United States and foreign patents, in which classification are listed alphabetically the names of the Officers and Industrial Fellows who in their association with the Institute during this period are responsible for them.

During this decade the number of Fellowships increased from 11 to 49, and the number of Fellows from 24 to 83, with a growth of Fellowship receipts from $39,700 in 1911-12 to $372,215 in 1921-22, which represents the contributions of individual industrialists, companies and associations of manufacturers to the maintenance of research workers in problems peculiar to the fields of their interest. Of the problems accepted by the Institute for study during the period covered by this bibliographic summary, 85 percent have been solved satisfactorily to the donors. The activities of the Institute, classified chronologically and by subjects, appear in the following table:

Contributions from the Mellon Institute

Year	Books	Bulletins	Research reports	Other scientific papers	United States patents issued
1912	1	1	15	12	—
1913	—	6	22	15	2
1914	—	3	13	27	10
1915	—	2	10	31	20
1916	2	1	14	18	18
1917	—	1	27	22	40
1918		2	21	16	14
1919		2	29	25	44
1920	1	1	41	62	11
1921	2	1	40	31	35

This bulletin not only is a notable representation of the service of Mellon Institute to industry, but serves admirably to indicate the dependence of industrial progress upon research, and at the same time gives to the research man the credit, often tardily withheld, for his contributions to the general welfare.

R. C. Mitchell, formerly Pacific Coast representative, Bush, Beach & Gent, Inc., 80 Maiden Lane, New York, is now in charge of advertising, the Mathieson Alkali Works, Inc., 25 W. 43d St., New York.

Safe Handling of Materials in Chemical Plants

By W. G. Whitman

Assistant Professor of Chemical Engineering, Massachusetts Institute of Technology

THE problem of safety in a chemical plant is complicated by the variety of potential risks which are always present. A general classification would divide these into two groups, viz., those hazards incident to any manufacturing operation and those due primarily to the chemical properties of the material handled. It is rather surprising to note that under normal conditions the accidents which may be classed as truly chemical average less than one-quarter of the total. Despite this fact the severity of injuries in chemical work runs higher than the average of other industries, and figures by the Massachusetts Industrial Accident Board indicate a 50 per cent greater severity rating.*

W. G. WHITMAN

Assistant Professor of Chemical Engineering Massachusetts Institute of Technology.

Non-Chemical Hazards

The popular feeling that chemical work is dangerous is caused primarily by the record of explosions and other catastrophes in plants operated at forced production during the war. The facts justified this sentiment at the time, but under present conditions such catastrophes are rare and the safety engineer classifies most of his accidents as non-chemical.

In view of these facts, why is the workman subject to greater hazards in a chemical plant than in other industrial work? In general there is less machinery to be found there and mechanical accidents, such as occur in mills, are rare. The most logical answer is found in the layout and condition of the buildings and equipment. In many cases the materials handled or fumes from them are corrosive to a greater or lesser degree on any structural material that may be employed. Extreme examples occur in acid manufacture where the manager may be obliged practically to replace his whole plant every two years. Such conditions invite accidents at every turn, and continuous care and precaution are required by the management and the workman. A guarded belt cannot be left unwatched; in a short time the guard will corrode, fall against the belt, and be removed by some workman. Wood floors and stagings become weakened as the wood and nails corrode; steel I-beams are eaten through; trucks and industrial cars rust rapidly—a hundred things are going to pieces simultaneously. And the inherent hazard of these conditions and the accidents which result would not be rated as chemical in nature.

All this has a marked psychological influence on the workman, particularly if he is unskilled and ignorant. If the most effective way of preventing accidents is by education, the safety man has one of his hardest problems here. A laborer accepts conditions as he finds them; if he must push carboys on a broken-down truck, walk up shaky stairs with broken railings and dodge under unprotected belts, he takes it all as part of the job and his morale is materially weakened.

This ever-present problem for the safety engineer cannot be over-stressed. It causes the common everyday accident, usually minor, and never is given the publicity of newspaper headlines, but a yearly analysis of the accident record shows it in its true light as the major hazard to be eliminated. The treatment by periodical inspections, foreman's reports, and regular upkeep and replacements with new and better equipment parallels that of any other industry, but the particular conditions require a diligence and concientiousness beyond the ordinary.

Chemical Hazards—Gases

The general principles involved in handling gases are well recognized. Those which are poisonous or disagreeable should be carried under suction to avoid leakage outward, while those which form explosive mixtures with air should be under a pressure greater than atmospheric. In most cases the suction or pressure should be as low as possible in order to prevent excessive leakage in or out, since equipment and piping are seldom free from leaks. In certain cases, however, as in the handling of poisonous gases, such as cyanide, the vital importance of safety requires that the suction be great enough to prevent the slightest possibility of outward leakage.

One frequent source of trouble is the clogging of gas lines due to the presence of foreign material or to faulty engineering in unduly constricting the flow of gas at one point. In reactions where gas is evolved from a still or vessel it frequently happens that at some stage in the process the gas evolution becomes too great for the exhaust fan capacity, and the fumes are driven out into the building. This condition often can be avoided by controlling the reaction: in a furnace by cutting down or even drawing the fire at that time; in a kettle by cooling through the water jacket or cooling coils. For such processes it is advisable to have a recording chart showing the temperature inside the reaction chamber, using cards which have the ideal line for the run already drawn for the workman to follow. Draft gages should be located at the beginning of a pressure line or just in front of a suction fan, and readings recorded on a routine log sheet.

Adequate ventilation for the worst conditions is essential and gas masks should be kept in the foreman's office ready for use. It is unsafe to rely on natural ventilation when there is danger of gassing, since this is always subject to weather conditions. The type of ventilation to be employed is determined by the character of the escaping vapors. Normal ventilation is upward, but if the gases are much heavier than air, the currents should be horizontal and should draw them from the leaking equipment away from the workman. It will be found that frequent inspection of gas lines to lute up the joints is well repaid in better working conditions and higher plant efficiency. The presence of large leaks will be indicated by readings at the draft gages at the fan or blower, although a decrease of effective pressure may be caused by clogging in the line or by corrosion in the fan.

---

*A paper presented at the 11th Annual Safety Congress of the National Safety Council, August 28-September 1, 1922, Detroit, Mich.

When repair work must be done on gas lines which are shut down it is essential to pull air through for some time before starting the job. This precaution is advisable even if the line is not to be opened, as otherwise the gas will no longer be under suction and will diffuse out. I have witnessed several such incidents where men were badly gassed in working around absorption towers which were shut down for the week-end.

Flammable vapors should be carried under a slight pressure; and the necessity for careful leakage control is determined by the explosive limits of the vapor-air mixture. Dr. W. K. Lewis, in a paper delivered before the engineering section of the National Safety Council last year, discussed the evaporation of volatile solvents. He points out the danger of evaporating flammable solvents in closed rooms when air is present, and describes the use of inert atmospheres such as carbon dioxide, nitrogen, and flue gas. It is general safety practice to fence in any plant where flammable gases and liquids are used and to require passes from the office for admittance.

Chemical Hazards—Liquids

The pumping, handling and storage of liquids cause innumerable accidents from carelessness or the lack of proper equipment. Many of the liquids are corrosive to the flesh and most of them are slippery on the floor and dangerous for that reason.

In installing eggs for acid pumping, the air line should be equipped with a safety valve to preclude the possibility of excessive pressure, and earthenware eggs should be protected by reinforced guard boxes. The discharge pipe should deliver into a covered vessel or be equipped with an air relief pipe before entering an open tank. Glass and hard rubber piping cannot be run in exposed places, and glass in particular should be so guarded that breaking the line will not allow acid to spray over the workmen. Where rubber tube joints are required for glass piping, they must be inspected periodically and replaced long before they are ready to give way.

In filling and moving carboys the workman is subjected to burns from drippings and splashings. In this work the man always wears gloves, and sometimes goggles and even masks are necessary. The difficulty of filling carboys without overflowing can be lessened by adequately lighting the work, preferably from the side. The overflow should drain away from the workman to a sump, and the vapors should be drawn off horizontally. The flooring should be even and in good repair; where funnels are used to take the discharge from an outlet cock they should be as large as possible and of vitrified ware. All earthenware cocks should be held in place by bridles. It is necessary to make the operation easy and simple since an awkward layout of the filling station is wasteful of money and productive of accidents.

Carboy trucking can be simplified by adopting the newer types of rubber-tired trucks which carry the carboy ahead of the wheels. The old one-wheel barrow truck is a danger, particularly when it gets loose and is wheeled over uneven ground. Regular boarded truck paths should be kept up and all carboys stoppered before moving them. Empty carboys constitute another hazard since they are set out with a little acid in the bottom. The safest practice is to invert and wash them before stacking in the pile.

When it is necessary to carry on control analyses in the plant, the worker should have adequate facilities in the way of an acid-proof stand, plenty of water and drain capacity, efficient lighting, and enough extra space for samples, bottles, etc. The workman cannot take even the simplest Baumé readings with any accuracy if he is required to use an old carboy as a stand and work in cramped and poorly-lighted surroundings. Furthermore it is often necessary to do this work with rubber gloves on the hands, and, of course, a goodly portion of the sample will be spilled. The best procedure is to do all this work in a separate room specially equipped for the purpose.

Overflowing Tanks

Among other hazards in handling liquids the habit of over-flowing tanks is widespread. For example, a pipe carrying liquor to a distant plant is fed through a pump controlled by a workman at the feed tank. Too often the man at the discharge tank does not know that liquor is coming over until his tank overflows, and then the only way he can notify the pump man to stop feeding is by closing the discharge valve. A telephone or bell system will overcome this trouble, but it is even better to install a pressure dial at the pump which reads directly the liquor level in the receiving tank. Several types of gages designed for this particular purpose are on the market. In cases where one man handles both the pump and the receiving tank the use of long auxiliary valve handles is advantageous.

Many of the liquor accidents are suffered by repair men who are over-confident and careless. Specific rules governing repair work are necessary, such as shutting off and locking the valve above the work, completely draining out any retained acid and releasing the pressure inside the line. An extra precaution which may be used is to blank off the line so that it is impossible for liquor to get down to the work. It is obvious that the men should always work above the pipe to avoid drips.

Filling Caustic Drums

Molten caustic can be loaded most easily into drums by siphoning directly from the pot. The drums, carried by a chain from an overhead monorail equipped as a weighing scale, are lowered into a pit to be filled, so that the danger to workmen is lessened. Even then, the men must wear goggles, rubber shoes, and rubber gloves, and the man controlling the siphon cock should be well outside the range of any splashing or overflow which might occur.

Crystallizing liquors are often run in open troughs rather than in pipes and should be controlled by valves or plugs at the feed end rather than at the discharge, as otherwise the trough will freeze when not in use and spill its contents on the next run.

Explosions

Serious explosions and catastrophes are fortunately less frequent in chemical work than they were a few years ago during the war. The battle against these hazards is ably supplemented by the special bulletins of the Bureau of Explosives and I shall not attempt any general discussion of a matter so broad in its scope. It might be well to call attention to one danger not generally emphasized which is brought up in connection with the tremendous nitrate explosion at Oppau.

The Travelers Standard of May, 1922, describes the frightful catastrophe at Oppau, Germany, when 10,000 tons of nitrate fertilizer were blown up, killing

500 people and injuring almost 2,000. The true cause of this explosion is unknown, but a logical theory is advanced which is based upon seepage of waste products into the soil. Whether this is the answer or not the risk involved in carelessly throwing spent sludges and liquors out on the ground is real. Nitrate liquors in contact with organic matter are particularly dangerous in this respect. For this reason, sludge ponds, drains, and sumps for seepage should be located with due reference to the character of the waste, the kind of soil, the nature and direction of drainage and the location of other dumps.

Summary

Chemical work is admittedly dangerous, but at the present time the main hazards are due to poor working conditions caused by excessive depreciation and corrosion in the plant. Serious explosions are rare, but they are an inherent hazard which must be guarded against with all possible precautions. The everyday job of a safety engineer is to ensure that his equipment is a long jump ahead of the breaking point, that the men engaged in handling dangerous material are educated to their risks, and that they are provided with the safest equipment and protection obtainable.

Stockholders of The Chemical Foundation, Inc.

THE Chemical Foundation, Inc., is the hub of the organic chemical industry of the United States. If the contention of the present administration that German patents seized under the preceding administration were acquired under circumstances that make national self-preservation secondary to the opportunity of aliens to pervert our patent system, then the spokes fall to the ground, and the vehicle of national self-sufficiency in the key essentials of peace and war is in imminent danger of destruction.

The answer to the question: To whom do the patents rightfully belong?, is pregnant with high uncertainty to the most assiduous group of technologists and business men that ever rushed to a nation's aid in the throes of her emergency. Patriotic fervor, tempered by the counsel of eminent jurisconsults, found expression in federal legislation under circumstances that now are characterized by a vacillating Chieftain as "such that full investigation becomes a public duty."

The question is not who shall receive royalties on certain patents in synthetic organic chemistry, but shall American industrial genius be subject to tribute to an alien system that sought to smite the hand ever spread graciously in succor to all the world. Whether trusteeship, with its legal complications, attaches to this property, is for the courts to decide, and in the uncertainty incident to all litigation great interests grope in the dark.

Capitalized at $500,000, The Chemical Foundation, Inc., has 4,000 shares of preferred and 1,000 shares of common, par value of $100 each. Both issues are restricted to 6 per cent dividend out of earnings which, in their option, The Foundation's trustees may distribute. This surplus must be used for educational work. To date no dividends have been paid. Preferred stock is retirable at the option of the trustees. It has no vote. Investment in the preferred stock represents the contributions of patriotic Americans to finance The Foundation's purposes to promote a new industry in the experimental stages of which hundreds of millions have been invested.

Any qualified manufacturer may receive a license from The Chemical Foundation, Inc., to manufacture under the patents secured by it. Payment for the privilege is made in royalties ranging from 5 per cent down. Materials for the government may be manufactured without royalty. In the three years of its existence, The Foundation has shown a deficit of over $200,000, accounted for by expenditures of $260,000 in publicity and educational work. In the same period, the United States Treasury has received, as custodian, $356,089.79 in royalties from 35 licenses of 60 licensed patents granted by the Federal Trade Commission. To secure this sum The Foundation instituted friendly actions in which the Government representative was joined as a co-defendant, which precipitated the Government's attack on The Foundation.

The Chemical Foundation, Inc., holds 5,068 patents, 873 trade marks, 492 copyrights, 55 contracts, and 22 applications, for which it paid $271,850. The preferred stockholders, listed below, together with the amount of their holdings, aggregate 158. Each purchaser of preferred stock, regardless of the number of shares, is allotted one share of common, the maximum common stock allottment being two shares.

The entire voting control is confined to the common stock, which is in trustees' hands. These trustees are Otto T. Bannard, chairman of the New York Trust Company; George L. Ingraham, former presiding justice of the Appellate Division of the Supreme Court of New York; Cleveland H. Dodge, of New York; B. Howell Griswold, Jr., of Alexander Brown & Co., Baltimore, and Bradley W. Palmer, of Boston. The trusteeship extends until 1936, by which time all patents will have expired.

Preferred Stockholders

Abbott Laboratories, Inc., Chicago, $800; Althouse Chemical Co., Reading, Pa., $400; Aluminum Co. of America, Pittsburgh, $800; American Aniline Products, Inc., New York, $800; American Cellulose & Chemical Mfg. Co., Ltd., New York, $800; American Chemical Society, New York, $800; American Cotton Oil Co., New York, $800; American Platinum Works, Newark, N. J., $800; American Printing Co., New York, $800; Aniline Dye & Chemical Co., Inc., New York, $800; Arnold Print Works, North Adams, Mass., $800; Armour Fertilizer Works, Chicago, $800; Aspinook Co., Jewett City, Conn., $800; Atlantic Dyestuffs Co., Boston, $400; F. E. Atteaux, Boston, Mass., $800; Ault & Wiborg Co., Cincinnati, $3,100.

Baker, H. J. & Bros., New York, $800; Baker & Co., Inc., Newark, N. J., $800; George A. Ball, Muncie, Ind. $800; Joseph Bancroft Sons Co., Wilmington, Del., $800; The Barrett Co., New York, $6,500; The Bayer & Co., Inc., New York, $800; Bethlehem Steel Co., Bethlehem, Pa., $800; C. Bischoff & Co., New York, $800; Borne, Scrymser & Co., New York, $800; H. Bower Chemical Manufacturing Co., Philadelphia, $800; Bronx Co., New York, $800; Brown & Co., Portland, Me., $800; Butterworth-Judson Corp., New York, $6,500.

Campbell, John & Co., New York, $3,100; Capudini Chemical Co., Raleigh, N. C., $400; Central Dyestuff & Chemical Co., Newark, N. J., $7,200; Antonin Chapel (Catskill Chemical Co.), Brooklyn, $800; Cheney Brothers, South Manchester, Conn., $800; Citro Chemical Co., Maywood, N. J., $400; B. P. Clapp Ammonia Co., New York, $400; R. H. Comey Co., Brooklyn, $800; Commercial Research Co., New York, $800; Commonwealth Chemical Corp., New York, $400; Consolidated Color & Chemical Co., New York, $6,500; Contact Process Co., Buffalo, $800; Crocker Burbank & Co., Fitchburg, Mass., $800; Samuel A. Crozer & Son, Upland, Pa., $800.

Davison Chemical Co., New York, $800; John C. Dehls, Newark, N. J., $800; Dermatological Research Laboratories, Philadelphia, $800; Detroit Chemical Works, Detroit, Mich., $800; Diamond Alkali Co., Pittsburgh, Pa., $800; Dicks-David Co., Inc., New York, $400; Digestive Ferments Co., Detroit, Mich., $400; John V. N. Dorr, New York, $800; Dow Chemical Co., Midland, Mich., $1,500; E. I. du Pont de Nemours & Co., Wilmington, Del., $84,100; Durex Chemical Co., New York, $400; Winthrop C. Durfee, Boston, $800; Dye Products & Chemical Co., Inc., New York, $400.

Eastern Drug Co., Boston, $800; Electric Boat Co., New York, $800; Electro Bleaching Gas Co., New York, $800; Charles Engelhard, New York, $800; The Essenkay Products Co., Chicago, Ill., $800; Essex Aniline Works, Inc., Boston, $500.

General Bakelite Co., New York, $800; General Ceramics Co., New York, $800; General Chemical Co., New York, $33,500; General Electric Co., Schenectady, N. Y. $800; Genessee Pure Food Co., Le Roy, N. Y., $800; George L. Gilmore, Lexington, Mass., $800; The Grasselli Chemical Co., Cleveland, $20,000.

Hanovia Chemical & Manufacturing Co., Newark, N. J., $800; Hardwick & Magee Co., Philadelphia, $800; The Heller & Merz Co., Newark, N. J., $13,200; Hercules Powder Co., Wilmington, Del., $800; Herf & Frerichs Chemical Co., St. Louis, $800; Hess Goldsmith & Co., New York, $800; Heyden Chemical Works, Garfield, N. J., $800; Hooker Electro Chemical Co., New York, $6,500.

Irvington Smelting & Refining Works, New York, $800; Isco Chemical Co., New York, $800.

Johnson & Johnson, New Brunswick, N. J., $800.

Kelly-Springfield Tire Co., New York, $800; E. C. Klipstein & Sons Co., New York, $800; Walter E. Knipe & Sons, Philadelphia, $800.

La Belle Iron Works, Steubenville, Ohio, $800; Lackawanna Steel Co., Lackawanna, N. Y., $800; Lehn & Fink, Inc., New York, $800; Lewiston Bleachery & Dye Works, Boston, $800; Eli Lilly Co., Indianapolis, $800; Lindsay Light Co., Chicago, $800; Lonsdale Co., Providence, $800; Lowell Bleachery, Lowell, Mass., $800; John Lucas & Co., Inc., Philadelphia, $800.

Mallincrodt Chemical Works, New York, $800; Marden, Orth & Hastings (Calco Chemical Co.), Bound Brook, N. J., $33,500; Francis T. Maxwell, Rockville, Conn., $800; McKesson & Robbins, New York, $400; Merck & Co., New York, $6,500; William S. Merrill Co., Cincinnati, $400; Merrimac Chemical Co., Boston, $11,900; Metals Disintegrating Co., Inc., New York, $400; H. A. Metz Laboratories, Inc., New York, $6,500; Millville Mfg. Co., Philadelphia, $800; Monroe Drug Co., Quincy, Ill., $400; Monsanto Chemical Works, St. Louis, $800; George H. Morrill Co., Norwood, Mass., $400; Mt. Hope Finishing Co., North Dighton, Mass., $800; Mutual Chemical Co. of America, New York, $800.

National Ammonia Co., St. Louis, $800; National Aniline & Chemical Co., New York, $25,100; National Electrolytic Co., Niagara Falls, $800; National Silk Dyeing Co., Paterson, N. J., $800; The Naugatuck Chemical Co., Naugatuck, Conn., $800; New Bedford & Agawam Finishing Co., East Wareham, Mass., $400; The Newport Co., Milwaukee, $13,200; Niagara Alkali Co., Niagara Falls, $800; Niagara Electro Chemical Co., Niagara, $400.

Ohio Chemical & Mfg. Co., Cleveland, $800.

Pacific Mills, Boston, $800; Parke, Davis & Co., Detroit, $800; Joseph E. Patchett, Keyser, W. Va., $800; Peerless Colors Co., Inc., Bound Brook, N. J., $800; Pennsylvania Salt Manufacturing Co., Philadelphia, $800; Permutit Co., New York, $800; Perth Amboy Chemical Works, Perth Amboy, N. J., $400; Charles Pfizer & Co., Inc., New York, $800; Philadelphia Textile Machine Co., Philadelphia, $800; Philadelphia Tapestry Mills, Philadelphia, $800; Powers, Weightman & Rosengarten Co., Philadelphia, $800.

Rector Chemical Co., New York, $400; Republic Iron & Steel Co., Youngstown, Ohio, $800; Rhodia Chemical Co., New York, $800; The Roessler & Hasslacher Chemical Co., New York, $800.

Sayles Finishing Plants, Saylesville, R. I., $800; Schieffelin & Co., New York, $400; Solvay Process Co., Syracuse, $800; Semet Solvay Co., Syracuse, $6,500; Sherwin-Williams Co., Cleveland, $3,100; Frederick-Stearns & Co., Detroit, $400; J. L. Stifel & Sons, Wheeling, W. Va., $800; [illegible]

Tartar Chemical Works (Royal Baking Powder Co.), New York, $400; Toch Brothers, New York, $400.

Union Carbide & Carbon Co., New York, $800; Union Bleaching & Finishing Co., Greenville, S. C., $800; United Drug Co., Boston, $800; United Piece Dye Works, Lodia, N. J., $800; United States Color & Chemical Co., Boston, $1,800; United States Finishing Co., New York, $800; United States Industrial Alcohol Co., New York, $800; The Upjohn Co., Kalamazoo, Mich., $800.

Viscoloid Co., Leominster, Mass., $800.

Wallau, George J., New York, $800; The Wanskuck Co., Providence, $800; West Virginia Pulp & Paper Co., New York, $800; Western Electric Co., Inc., New York, $800; Jacques Wolfe Co., Passaic, N. J., $800.

Youngstown Sheet & Tube Co., Youngstown, Ohio, $800.

Zinsser & Co., Hastings, N. Y., $800.

Proverbs VII, 14; Matthew V, 44; Proverbs II, 11

DR. ALFRED MULLER
Member, American Patent Law Association
Foreign Member, Chartered Institute P. A.
565 Fifth Ave., New York, Aug. 17, 1922.

Editor, Chemical Age.

Dear Sir—In May Chemical Age appeared the reprint of a letter written by the President of Bowdoin College, Brunswick, Maine, in reply to an appeal addressed by the University of Tübingen, Germany, to American universities, schools, societies, etc. The said letter contained the following sentence:

> I feel that intellectual Germany has not yet made restitution for the harm that it did the world in advocating war in 1914, and until there is some sign that the scientists and scholars of Germany feel some sense of repentance for the woe which their country has brought on the world, both personally and officially, I desire to have no part in a movement that seeks to support German culture and German science.

Without wishing to refer Dr. Sills to all that has been revealed *since* the war by persons who have had inside knowledge and which therefore throws an entirely different light on the war and the ultimate causes that led to it, I feel like making a few remarks on this subject which is still dominating the world.

If the countries which were engaged in the war and no less the countries which had no direct part in the war are ever to emerge from the terrible effects of the great crime against humanity, then there is only ***one*** way, and that is *cooperation,* and it must be cooperation with *good will!* As no man can live to himself, so no nation can nowadays live to itself. The thoroughly unsatisfactory present conditions all around will drag on indefinitely and will lead finally to a situation equally deplorable with what existed during the war, if there is no change of heart.

The way to resume friendly relations is to resume them. The world cannot go on as it does today, still filled with prejudices and hatreds. There can be no progress by living in the past and harking back to what has been. The way to progress is to look ahead, forgetting the past and strive for better conditions.

There is no improvement like improved knowledge, and the work toward better mutual understanding should be the guiding aim of all, and especially of the leaders in science and in government. What can be expected of the great mass of people, unless an example is set them by their leaders? And how can better mutual understanding and progress be achieved, unless those in high positions show the way, in word as well as in deed? Good will is born of tolerance, and tolerance is the keystone of civilization. To work for the good of all means to work for the good of everyone, and for that we need cooperation.

Yours very truly,

Dr. Alfred Muller

Manufacture of White Potato Flour

By W. A. Noel, M.E.

Associate Development Engineer, Office of Development Work, Bureau of Chemistry, U. S. Dept. of Agriculture

W. A. NOEL, M.E.

WHITE potato flour was manufactured during the war and offered to the public as a substitute for wheat flour. Due to the food shortage and prompted by patriotic motives, a large number of people were very enthusiastic about using it, but when the necessity for substitutes no longer existed, the demand for potato flour ceased.

In the first attempts at manufacturing potato flour, the processes used were rather crude as compared with later methods. The process as formerly carried out was one evolved by the dehydration enthusiast. He made his flour by grinding the dried chips of dehydrated potatoes.[*] This method proved to be an expensive one, hence not practicable. A great deal of hand labor was required in slicing and drying and grinding. The long time required to dry the potatoes restricted the output so that the flour had to be sold at an extravagant price.

About 1917 the "hot drum" or roller process was brought to this country from Germany where it had been in use for some time. Before the war, considerable quantities of potato flour starch were made in the Netherlands, Denmark, and Germany. The flour made at first was used for stock feed. The process, however, was improved and the flour later produced for human consumption. When an attempt was made to manufacture potato flour in America by the roller process, the war prevented importation of machinery so the "flaking" machines were constructed here. Much attention was given to producing flour and a better product was manufactured here than had been imported before the war.

White Potato Crop and Its Utilization

Of all the vegetables raised in America, no one crop is of more importance than the white potato. In 1920 there were 430,458,000 bushels raised in the United States. Approximately 50,000,000 bushels of these potatoes were wasted in spite of the fact that the good keeping qualities of the potato, together with its food value, are responsible for the important position that it occupies in the category of vegetable diet.

The larger and more regular shaped tubers are selected for table use, while the smaller and irregular shaped ones are undesirable. The effect of this preference reacts on the grower to his disadvantage and financial loss. It is necessary for him to sort out the best ones and to discard the others in order to get a good price. This sorting has been done without any well established precedent, each case being handled according to the dictates of the individual doing the sorting. Recently, the U. S. Department of Agriculture has established standard grades for potatoes, classifying them as U. S. No. 1 and U. S. No. 2. These grades are enforced in some states, while they are followed voluntarily in others, which tends to overcome the lack of uniformity.

Ordinarily, the U. S. No. 1 grade of potatoes is all sold at a good price. The U. S. No. 2 grade is usually sold at a lower price and those not fit for the second grade are thrown away or used as stock feed. In this latter class are found culls, frosted, sunburned, second growth, cut, rotted, scabby, blighted, and other diseased or mechanically injured stock. During years of plenty, only the very best potatoes will find ready sale at a good price, while during short crop years the No. 2 grade will perhaps command as good a market value as the No. 1 grade, but the culls will be little affected by market conditions.

The potato starch industry has in the past utilized some of the cull stock. A high-grade potato starch can be procured from very low-grade raw material, including otherwise worthless frozen stock. The price of potato starch is usually very low, being governed by the market value of corn and other starches rather than by the supply of potatoes. On this account the potato starch manufacturer must depend on securing his raw product at a very low price, excluding as a rule No. 2 potatoes from his supply.

The potato flour industry, making use as it does of a raw product that must of necessity be superior to the low-grade cull stock but not necessarily of the first grade, should do much toward stabilizing the potato market by equalizing the demand year by year, and at the same time stimulate the agricultural pursuits producing the crop. In the manufacture of starch a yield of 16 per cent. is obtained, whereas in the manufacture of flour a yield of 20 per cent is obtained. The potato flour is used as a natural qualitative additive in the baking of bread, the manufacture of macaroni, sausage, etc., and accordingly commands a better price on the market, hence the potato flour manufacturer can outbid the potato starch manufacturer for No. 2 potatoes and the better culls. He must, however, secure his potatoes at a comparatively low figure since raw material costs amount to more than 50 per cent. of his entire manufacturing costs. Although at some future time the potato flour industry may prove to be commercially successful, the production of potato flour cannot be recommended at the present time in the United States as a method for utilizing potatoes.

The margin of profit in potato flour manufacture under normal conditions will not be large, so to be profitable a rather large production will be necessary. A unit installation having a capacity of 20 tons of fresh potatoes per day is the minimum advisable capacity. This will mean a production of 4 tons of flour per day. Under favorable conditions a plant may be expected to operate seven months a year.

Manufacturing Procedure

For the manufacture of flour from Irish potatoes, the author has prepared designs containing improved ideas and advance thought on the layout, construction, etc., of a plant for efficiency, economy, and continuous operation at low operating cost through elimination of all possible dispensable hand labor. The different steps involved in the manufacture of flour are as follows: First, the potatoes are washed, then peeled, sorted, cooked, macerated, dehydrated, ground, bolted, and packed.

Washing. The type of washer used consists essentially of a wooden or concrete tub approximately 3 ft. x 3 ft. x 15 ft., fitted with a false slat bottom and

---

The author acknowledges the assistance rendered by C. [illegible] formerly of the Bureau of Chemistry, in obtaining the data contained in this article.

divided by partitions into three sections. A series of paddles are attached to a central longitudinal shaft, and plumbing connections are provided so as to fill the tub with running water and care for the overflow and drain-off of dirt and stones. The potatoes are fed into the head end of the tub and worked through the water by the agitator paddles, being transferred from one section to another by the lift paddles. This agitating action of potatoes with potatoes and with the water and paddles, removes the adhering soil, etc. A small drag elevator picks up the potatoes now smooth and clean and conveys them to the peeling machine.

Peeling. The peeling is done by the use of friction paring machines. There are several makes of this type of vegetable paring machine on the market at present, but the principle of operation in all is the same. Friction paring machines consist essentially of a cylindrical container with a revolving concave plate as a bottom. The bottom always has a roughened surface and the sides may be either smooth or rough. The revolving of the bottom serves to bring all the potatoes in contact with a roughened surface; the water sprayed on the potatoes carries away the pulped peel.

The paring machine removes not only the thin peel but also a portion of the white flesh of the potatoes. Therefore, if the potatoes are subjected to the action of the peeler for a greater length of time than necessary, a portion of the potatoes will be pulped, carried away, and wasted. It is necessary, therefore, to control very closely the length of time the potatoes are subjected to the action of the peeler. In making potato flour, it is not necessary to remove every particle of peel from the potato, but only the major portion. The potatoes should never be left in the paring machine until the "eyes" are entirely removed. Under ordinary operating conditions, and using clean well-washed potatoes, one minute in the paring machine should be the maximum time and in most cases half that time will be ample.

No Advantage in Combining Preceding Steps. Attempts have been made to both wash and peel the potatoes in one operation—using the paring machine for this purpose. The stream of water playing on the potatoes during the paring operation was used to remove and carry away the adhering earth and sand. In order to insure the removal of the dirt, however, it was necessary to keep the potatoes in the paring machine for some length of time. This method, therefore, caused a larger waste of potatoes than was permissible, and the yield of flour per bushel of potatoes was much reduced.

In addition to the waste of potatoes and a consequent decrease in yield of flour, there is a second disadvantage to combining these two operations. The sludge from the peelers contains a considerable percentage of potato starch which may be advantageously recovered if the mixture is free from dirt. If the mixture contains sand and especially the finer earthy material, it will not be possible to recover a clean white starch. So the operations of washing and peeling should be performed separately. At least two friction paring machines are desirable. They may then be operated alternately, i.e., while one is operating the other machine is being emptied and refilled.

The potatoes are transferred from bins to the washing machine by an incline drag elevator. After washing they are conveyed to the paring machine where they are pared for 30 [illegible] seconds. From the paring machines the potatoes drop onto the sorting belt where rotten, discolored, or useless material is eliminated. This is best accomplished after the washing and paring operations and just before the potatoes are carried to the storage bins above the cooker. For the purpose of sorting, a rubber belt conveyer 12-15 in. wide and at least 8 ft. long is advisable. If the potatoes used are in good condition, two operators on this type of sorting table will be sufficient. If potatoes are in very poor condition, sorting before they enter the washing machine is advisable. The sorting belt drops them into a drag elevator which carries the potatoes to the storage bin above the cooker.

Cooking. A steam pressure cooker is used for cooking, the simplest form consisting of a cylindrical iron tank with cone-shaped bottom to insure drainage. This tank is fitted with a perforated false bottom and is further provided with two openings of about one square foot each—one on the top for introducing the potatoes, and one opening on the side near the bottom for removing potatoes after cooking. In this cooker, the doors over the two openings are closed tightly after filling with potatoes and steam is introduced from near the top and the pressure allowed to rise to 15 pounds. The steam passes through the potatoes and the water of condensation collects in the space under the false bottom. A small pipe connected with a steam trap takes care of the excess condensation. Fifteen to twenty minutes' cooking under 15 pounds pressure is generally sufficient. The potatoes should be cooked soft.

Flaking. When cooking is complete, the steam is shut off, the lower valve and lower door opened, and the potatoes are allowed to roll out into a screw conveyor which carries them to the flaking machine, mashing them in the operation.

The potatoes, cooked and mashed, now fall onto the hot revolving drums of the flaking machine, Fig. 1, where they are dehydrated. The drying or flaking of the cooked potato is a very important step in making potato flour, and the flaking machine is the most costly piece of equipment required for the plant. The potato flaking machine was developed in Europe, but different types of this machine have been designed and built by American engineers. While machines of different makes will differ somewhat in design and construction, the principle involved is the same. It consists essentially of a large, revolving steel cylinder or drum with a smooth outer surface. This cylinder or drum is heated by live steam at 80 pounds or more pressure. This means that the temperature of the smooth outer surface is 325° F. or more.

The cooked potatoes are mashed and brought into contact with the heated surface of the large drum. Smaller steel rollers spread the mashed potato into a very thin layer or film on the surface of the drum. The moisture in the potato evaporates rapidly and by the time the drum has completed about ¾ of a revolution, the thin layer of potato is completely dry and is removed as "flakes" by stripper blades set against the drum.

A flaking machine should be properly installed. A firm base should be provided and all parts should be accessible for adjustments and repair. It is very important that the devices for adjusting the stripper blades be accessible. A vapor hood and an outlet pipe

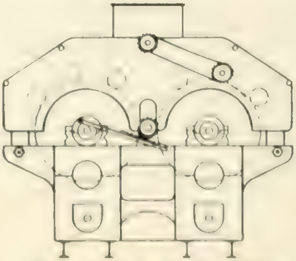


Fig. 1—Section of Flaking Machine

are shown above the flaker on the elevation drawing. Some form of vapor hood provided with an exhaust fan is necessary for carrying away the steam resulting from the drying of the potatoes. As the dry flakes are stripped off the drum, they fall into a screw conveyor which carries them to a bucket elevator which carries them to the flake storage bin.

Grinding and Packing. The storage bin for flakes is directly above the attrition mill into which the flakes are fed and ground. Different types of mills have been used for grinding the flakes into flour, but the most satisfactory type used has been the attrition mill. These mills may be belt-driven, but a direct motor drive also may be used. The ground material passes downward into the boot of a bucket elevator which carries the ground flakes to the centrifugal reel for bolting.

A centrifugal reel of the type ordinarily used in flour mills, with 10xx bolting cloth, may be used. The "tailings" are reground. The coarse material, or "tailings," which does not pass through the bolting cloth passes back to the storage bin for flakes and directly to the mill to be reground. The finely bolted flour is conveyed to the storage bin over the packer where it is packed into bags or barrels the same as are used for wheat flour. A paper lined bag or barrel is preferable. This completes the manufacture and the flour is ready for shipment or storage.

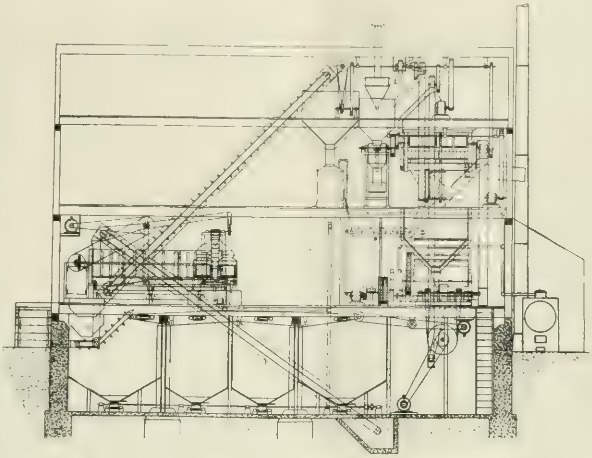


Fig. 2. Elevation of plant for the manufacture of white potato flour.

Dust

A cyclone dust collector should be installed on the top floor with aspiration on the head of the elevator which carries the flakes from the flaking machine to the attrition mill; also on the stock stream to the attrition mill, on the elevator which carries the ground flakes to the reel and on the elevator to the bin over the packer.

A dusty mill is to be avoided. Escaping dust not only mean a reduced output but its presence may cause a disastrous explosion and conflagration. The economy of such an installation is obvious and would tend to pay for itself in the flour saved, which would ordinarily, without such a system, be disseminated through the plant as dust and cleaned out by an occasional sweeping as dirt.

Building and Equipment

Figure 2 shows in elevation the equipment necessary installed to scale in a building 32 ft. x 52 ft. The boiler room is an 8 ft. lean-to adjacent to the main building. The layout of the plant, Fig. 2, shows the basement used as storage space for potatoes; the first floor divided into four main rooms, viz., office, room for washing, paring and sorting; room for flaking machine; and room for milling; the second floor with the cooker, bolter, packer, and storage space provided; and the top floor or attic for the cyclone dust collector.

In order to prolong the operating season through the severe winter months experienced in the northern potato growing states without exposing the potatoes to the cold, freezing conditions attending transportation, it is necessary to have a large storage capacity available. In anticipation of this, the basement may be used for what might be termed a working storage, and the main supply of potatoes stored in low storage bins or houses adjacent to or near the main building, transferring them by means of a belt conveyor operating through a tunnel underground.

The plant must be near a railroad and be provided with a siding for unloading potatoes and shipping out the finished product. By making provision for expansion of this plant, an agricultural district, engaged in raising potatoes, of 100 miles radius can be taken care of.

The following equipment is used in manufacturing potato flour:

1 high pressure boiler, 50-150 h.p.,
1 potato washing machine,
2 or more friction paring machines,
1 steam pressure potato cooker,
1 sorting table,
1 potato flaking machine with vapor hood and suction fan,
1 attrition mill,
1 centrifugal flour reel.

Yield

Exact figures for yield of flour cannot be given since it will vary with the solid content of the potatoes used, the percentage of rotten potatoes thrown out, and the process of manufacture. Assuming that potatoes used have an average solids-content of about 22 per cent. and that only sound stock is used, if the procedure of manufacture as just outlined is followed, a yield of 20 per cent may be expected. This means that 100 pounds of fresh potatoes will produce approximately 20 pounds of potato flour, containing 5 to 10 per cent. of water, a ratio of 5:1.

Emphasis has been placed on the necessity for partially peeling the potatoes to obtain a high-grade flour and the most economical methods have been advised. A yield of 20 per cent. therefore should be considered as the maximum figure rather than the average, although with careful operation and potatoes of average solids-content, this figure is readily attained.

Composition of Potatoes and Flour

Chemical analyses of the potatoes used and the resulting potato flour show that in the process of manufacture, no appreciable amount of valuable constituents is lost from the original composition of potatoes. Considering the nutritive value of potato flour and potatoes, we find the mineral constituents to be practically the same.

Atwater & Bryant in Bulletin 28, U. S. D. A., give the average composition of 136 samples of the edible portion of American grown potatoes as follows:

Water	78.3 per cent	Carbohydrate ..	18.4 per cent
Protein	2.2 " "	Fibre	0.4 " "
Fat	0.1 " "	Ash	1.0 " "

Analyses by the Plant Chemical Laboratory, Bureau of Chemistry, for the Division of Dehydration, are given in the accompanying tables, I-VI.

Table 1—Composition of Fresh Potatoes

Sample	Water	Fat (Ether Extract)	Protein (Nx 6.25)	Crude Fibre	Total Ash	Starch (Diastase)	N.-Free Extract	CaO	MgO	K_2O	P_2O_5	S	Cl_2
1	78.07	0.078	2.38	0.62	0.99	14.37	17.86	trace	0.052	0.46	0.146	0.030	0.017
2	77.03	0.123	2.56	0.55	0.99	15.70	18.75	trace	0.056	0.52	0.134	0.038	0.020
3	75.02	0.160	1.69	0.54	1.42	18.26	21.17	0.040	0.064	0.65	0.140	0.031	0.061
4	76.11	0.080	2.01	0.56	1.03	16.25	20.21	0.017	0.069	0.57	0.174	0.026	0.062
Table II—Composition of Natural Potato Flour Made from Peeled Potatoes and Bolted													
1	6.41	0.312	10.44	2.36	3.29	63.73	77.19	trace	0.205	1.70	0.557	0.136	0.062
2	8.50	0.425	9.81	1.59	3.49	63.71	76.19	trace	0.181	1.84	0.525	0.142	0.063
3	8.57	0.551	8.00	1.55	4.90	63.38	76.43	0.132	0.225	2.27	0.473	0.126	0.180
4	6.85	0.190	7.44	1.53	3.93	57.89	80.06	0.100	0.240	2.07	0.610	0.106	0.067
Table III—Composition of Natural Potato Flour Made from Unpeeled Potatoes and Unbolted													
1	6.40	0.16	7.98	1.66	4.53	62.62	79.27	0.125	0.242	2.32	0.410	0.132	0.160
2	7.11	0.16	8.04	1.54	4.55	62.80	78.60	0.135	0.240	2.33	0.440	0.128	0.170
3	6.55	0.17	8.04	1.66	4.34	63.02	79.24	0.100	0.260	2.34	0.415	0.098	0.130
Table IV—Fresh Potatoes													
1	....	0.354	10.94	2.81	4.50	65.53	81.40	trace	0.236	2.12	0.667	0.136	0.076
2	....	0.537	11.25	2.40	4.33	68.35	81.48	trace	0.243	2.27	0.584	0.164	0.086
3	....	0.639	6.88	2.17	5.70	73.10	84.61	0.161	0.256	2.60	0.570	0.126	0.243
4	....	0.320	8.69	2.35	4.31	68.00	84.33	0.070	0.290	2.39	0.730	0.108	0.260
Average ...	....	0.463	9.44	2.43	4.71	68.75	82.96	0.058	0.256	2.35	0.638	0.134	0.166
Table V—Flour Made from Peeled Potatoes and Bolted													
1	....	0.333	11.12	2.52	3.51	68.10	81.52	trace	0.219	1.82	0.595	0.145	0.066
2	....	0.464	10.75	1.74	3.82	69.63	83.23	trace	0.198	2.01	0.574	0.155	0.169
3	....	0.603	8.69	1.70	5.36	69.32	83.65	0.144	0.246	2.48	0.517	0.138	0.197
4	....	0.200	8.00	1.64	4.22	62.15	85.94	0.107	0.279	2.22	0.655	0.109	0.072
Average ...	...	0.400	9.64	1.90	4.23	67.30	83.83	0.063	0.236	2.13	0.585	0.137	0.101
Table VI—Flour Made from Unpeeled Potatoes and Unbolted													
1	....	0.170	8.38	1.77	4.84	66.90	84.84	0.134	0.259	2.48	0.438	0.141	0.171
2	....	0.170	8.56	1.66	4.90	67.61	84.71	0.145	0.258	2.51	0.474	0.138	0.183
3	....	0.180	8.50	1.78	4.64	67.44	84.90	0.107	0.278	2.50	0.444	0.105	0.139
Average ...	....	0.173	8.48	1.74	4.79	67.32	84.817	0.129	0.265	2.50	0.452	0.128	0.164

Manufacturing Cost

The cost of manufacture naturally will vary with labor conditions and price of fuel and power. With a production of 6,000 to 8,000 pounds of flour per day, cost of manufacture, exclusive of overhead expenses and depreciation charges, will vary between $80 and $90 per ton of dry flour. At present prices for labor and fuel, the larger figure is probably more nearly correct.

About one-sixth of the cost will be for labor. The number of laborers here listed for one shift will indicate the possible labor expense.

1 plant manager
1 general utility mechanic
1 fireman
3 or more men for handling incoming raw material, for packing and shipping out flour
1 laborer for washing potatoes
1 laborer for operating paring machines
2 or more (male or female) laborers for picking belt
1 laborer for cooking
2 or more men for operating flaking machine
1 man for operating mill

Production Cost

The cost of production will equal the manufacturing cost plus the overhead. Taking into account the cost of potatoes and the manufacturing cost exclusive of the cost of potatoes, the following table will show the great variation in the cost of manufacturing as affected by the market price of potatoes:

1 Cost of potatoes per cwt.	2 Cost of potatoes per lb. of flour	3 Cost of mfr. exclusive of potatoes.	4 Ratio of column 2 to column 3.
.30	.015	.019	.79
.60	.030	.019	1.58
.90	.045	.019	2.37
1.20	.060	.019	3.17

In many industries the raw material cost is a small item, or sometimes almost nil, but in the manufacture of potato flour it will more than likely equal the total of the other cost items entering into the cost of manufacture. If the plant is of a one-unit capacity, the manufacturing cost will, of course, be higher than if it were equipped with two flakers and the necessary cooking capacity. By thus increasing the output 100 per cent the production cost would also be increased, but not in such a great proportion, so that the cost of production would be lowered with increased capacity.

Below is an itemized statement of the cost of operating a single unit plant for the manufacture of one carload (40,000 lbs.) of $.60 potatoes into flour in one day:

Cost to Produce One Pound of Flour

(Calculations based on prices prevailing in 1919)

Potatoes (60c. cwt.)	$0.03000
Labor	.00700
Power ($15 per day)	.00187
Coal ($15 per day)..	.00187
Machinery depreciation ($12,000 at 10%)	.00075
Building depreciation ($15,000 at 3%)...	.00028
Packing (sacks, 30c.)	.00300
Factory cost.........	.04477
Overhead	.00437
Manufacturing cost...	.04914
Selling expense, 20% of mfg. cost.......	.00982
Total cost	.05897
Profit, 10%	.00589
Selling price per lb...	.06487

References: Handbuch der Kartoffeltrocknerei, Dr. Edmund Parow; Die Kartoffeltrocknung, J. Kutishauser; Maschinenprufungen, Erstes Heft, Hauptprufungen von Kartoffeltrockenapparaten und Kartoffelerntemaschinen Deutsche Landwirtschafts-Gesellschaft, 163.

It has been announced by the *Journal du Commerce*, Paris, France, that a definite agreement has been concluded between the Badische Anilin und Sodafabrik and the Compagnie Nationale des Matieres Colorantes et de Produits Chimiques, whereby the French company abandons all competition with the German concern outside France, in exchange for which it receives the German working secrets. The Germans on their part abandon all competition with the French in France. The Compagnie Nationale, which was established five years ago with Government assistance, in its current annual report admits its dependence upon the experience and assistance of its foreign competitors in the following words:

"The work of even the best technicians must be sterile unless they are in possession of all the knowledge accumulated in the past—knowledge which is essential to success. All who understand the complexity of the manufacture of organic coloring matters will realize why we have been compelled to acquire patents, the processes and the technical aid of our principal foreign competitors for exclusive use in France."

The Practice of Consulting Chemistry as a Profession in New York

By L. R. Seidell
Manager, Testing Laboratories of New York, Inc.

IN the classified telephone directory of New York City, under the heading of "Chemists-Analytical" are listed the names of eighty-eight men or firms, and under the heading "Chemists Consulting," are listed fifty-seven names, some of which may be duplicates. In the "Annual Chemical Directory," under the heading, "Industrial Chemists and Chemical Engineers," are given the names of one hundred and ninety-one men or firms with New York City addresses. From information at hand this is probably the largest collection of consulting chemists in captivity.

New York, rightly or wrongly, usually lays claim to the biggest or best of everything, and believes that the paths of the majority of the most prominent or most successful men of all professions lead eventually to its bosom. Accepting this as correct, it naturally will be assumed that in New York the profession of the consulting chemist has reached its highest plane, as regards the quality of the men, the opportunities presented, fees, recognition granted, etc. There probably are many chemists of wide reputation in their particular line, the height of whose ambition is to establish themselves as consulting chemists in New York. Existing conditions as seen by the writer in his contact with many of the leaders in the profession of consulting chemistry, and in the other professions and also with the many different lines of business whom we are called upon to serve, may be of interest.

Is Chemistry a Profession?

Broadly speaking, a profession is a man's calling or vocation, and as such it may be carpentry, bricklaying, plumbing and steam-fitting, etc., but in its highest sense it is considered to be a specialized knowledge of some particular art or science and the intelligent use of such knowledge in our different relations with each other. We all probably will admit that the highest type of professions are those of the law, medicine, ministry and teaching, so it is only natural in considering chemistry as a profession to compare the status of the chemist with that of the lawyer and physician who have done most in organized consideration of their respective common problems.

One usually thinks of the lawyer as furnishing legal advice to his clients in his office, or of pleading their cases in court; of the physician as examining his patients in his office and advising or prescribing for them or operating on them later. In these times of the high cost of living, any of us who have had dealings with these professions know that such contacts are expensive, to say the least. It, therefore, would give us great pleasure to visualize the consulting chemist as installed in a handsomely furnished office, his large library just off to the left, meeting his numerous clients, probably by appointment, and after a consideration of their problems in the fierce light of his knowledge and experience, prescribing for them, advising them, or if necessary, visiting their plants so that he may better operate on them. All of this for a handsome fee, respectfully presented at the end of the interview.

Do such actual conditions exist? I'll venture to say, without fear of contradiction, that there are not six consulting chemists in the City of New York, depending on consulting work alone and with no other source of income, who are successful financially. There seems to be some deep rooted aversion in industry, even among the other professions, to paying a chemist, in a consulting capacity, a fee for his advice or knowledge.

Tests, chemical or physical, involving actual labor, will without question command fees running from fair to extortionate, but the opinion of a chemist, which is usually of far more value and may often involve far more labor, is accepted often without thanks and usually with a great deal of surprise if accompanied by a bill for services. This partly may be the fault of the chemist in not placing the proper valuation on his services. Even our good friends among the lawyers or physicians usually will ask us around to their office, easing their path toward the fee before they consider our simple case, but how often are we compelled to give gratuitous advice frequently to strangers. Often we go to great pains so that we can give this advice and I'm inclined to believe that we chemists do it so cheerfully so we can show the world how much we really know. Here it seems to me is one of the first points of difference beteen the profession of Consulting Chemistry and that of the lawyer or physician.

As I stated before, although it is an easy matter for the consulting chemist to charge for the work of his laboratory it is difficult to charge for consultations. This makes necessary the possession of a laboratory and if on a small scale, it means that the consulting chemist must do practically all of his own work. Many chemists, on account of their experience, specialize along some particular industry such as oils, leathers, fuels, agricultural products, and in such cases it is perhaps necessary to have merely a moderate sum invested in equipment. If the chemist wants to cover a general line of chemical work it will mean quite a heavy investment on his part, since the work may cover metals, oils, drugs and chemicals, cements, fuels, textiles and many other lines, and the work may cover not only the chemical but also the physical testing of the different materials. The general chemical practitioner has the advantage over the specialist in the fact that while one line of business may be very dull, the other line may be prosperous; he is not handicapped by dull seasons in any particular business.

Having the equipment, we are now confronted with the high rents existing in New York, salaries, advertising, and all other charges which go to make up old friend "over head:" Let us take for example a chemist who has $5,000 to invest in equipment, is able to secure fair quarters for $100 a month, does a small amount of advertising and decides that his services in his undertaking should be worth $300 per month. His expenses and carrying charges will average $200 per month, which with his salary will mean that he must produce $500 worth of work per month or approximately $20 per day. This does not seem difficult, but we must remember that these expenses are sure day after day, while the work coming in may vary.

The majority of the consulting chemists listed in New York are probably individuals, doing business according to the example I noted. When we come to the general chemical laboratory, we generally find that the equipment necessary is so extensive and other conditions such that it is impossible for a chemist to conduct the business as an individual. Hence we find that the biggest laboratories are corporations, sometime making use of the name of the founder, sometimes using a trade name, but nevertheless, the individuality of the chemist is lost.

Competition—Fair and Otherwise

A beginner in the field then will find not only that he must enter into competition with well established laboratories of individuals or comparatively wealthy corporations, but he also will encounter what, from our angle, appears to be rather unfair competition from an unexpected quarter. The consulting chemist will find that he is continually encountering the competition of professors and instructors in chemistry of the various institutions located in the city. I feel that this competition is decidedly unfair because these men have the free use of the equipment of the institutions for which they are working, have no other overhead expenses and in addition usually are able to make use of their students in such work at no expense to themselves.

There is at one institution a department which frankly makes a business of its particular line of commercial testing work which properly should find its way to the commercial testing laboratory. Although there are undoubtedly good reasons why such competition should exist, there is no doubt but that under present conditions the competition is often unfair, and constitutes what should be a matter of regulation by one of the existing organizations with the assumed interest of the chemist at heart, if such exists.

There also is a large organization which frankly admits that it is not in the field for the purpose of making money, and that the group of philanthropists supporting it have to make good a large annual deficit. If this organization confined its efforts to its particular field not so much can be said concerning it. However, when it invades other fields it becomes a matter of unfair competition to the consulting chemists of New York and the aforementioned philanthropists deserve perhaps a different name.

Nature of the Work

The members of the faculties of our institution of learning will take perhaps the cream of the purely consulting chemical work. To the consulting chemist there is left, of course, a large amount of the same kind of work which is usually very variable in volume. There are some men in the field who can depend on their connections with several firms to assure them of steady and sufficient income, but such connections are rare and difficult to make. When any firm has work of such volume, it appears to be their policy to establish its own laboratory, under the impression that it is cheaper to do so, and also that they can secure better service.

There is a large amount of work to be found among the inventors or originators of new metals or other materials, or new processes, in connection with law suits or from firms having trouble with their raw materials, or manufacturing processes. This class of work also is rather variable as to quantity, and cannot be depended upon for a steady income.

There remains the routine inspection, analysis, or testing for the commercial plants in New York and vicinity, and it does in the aggregate constitute a large volume of steady business. It covers all branches of chemistry, however, and requires a large amount of equipment to handle properly. There is keen competition for this grade of business; much of it is handled under contract and at quite low prices. It is perhaps another blow to our pride as professional men to know that bids often are called for from different laboratories, and the work goes to the lowest bidder. This branch of the work is in fact not a profession but a highly developed business in which the efficient and economical conduct of the laboratory, proper advertising, business-getting ability, the ability to satisfy and hold customers, credit ratings, collections, etc., determine whether or not your laboratory is going to be successful.

Organization Needed

It seems to be natural with us to form organizations in the different lines of business and in view of the large number of individuals and laboratories in New York City engaged in the practice of consulting chemistry it is strange that no similar organization has been formed among them. I believe there is a strong need for such an organization which could be made of great benefit to the members themselves, and eventually to the City of New York as a whole.

For instance, prices could be standardized, unfair competition could be eliminated, both the members and the public could be educated as to the work carried on by the different laboratories, and eventually a code of ethics could be evolved of vast benefit to all. It also could work toward securing proper recognition of the profession in the life of the city. Just for instance, the disposal of oil waste from oil-burning ships has become a serious problem along the water front of the Atlantic Coast. Among all the committees appointed to study this matter and suggest some relief, I have not seen the name of one chemist, and, properly, the investigation should be in the hands of a chemist.

Outlook for the Newcomer

I have been asked whether I would advise one who was qualified, to engage in the practice of consulting chemistry in New York. It is a difficult question to answer. With the wealth of opportunities which New York presents in all fields of endeavor, I feel that there is always an opportunity for the newcomer successfully to establish himself in the practice of consulting chemistry here in New York, considering of course the following obstacles with which he will have to contend:

1. Heavy expense, such as rents, salaries, etc.
2. Constant advertising.
3. Serious and not very well regulated competition.
4. Necessity for a well-equipped laboratory.
5. The presence of many well-equipped laboratories of wide reputation, many of them well-financed corporations.

With the above in mind, there will be with us the constant hope that we may escape the fate of the mining engineer mentioned in one of the technical journals who decided to retire on the twenty-five thousand dollars which he had accumulated.

This sum represented his savings of thirty years of faithful and efficient service and a legacy of twenty-four thousand nine hundred and ninety-five dollars.

E. M. Chase has been assigned to the direction of the experimental work in food dehydration of the Bureau of Chemistry, U. S. Department of Agriculture, which has been transferred to Los Angeles, Calif. Associated with him are W. A. Noel, Ray Powers, C. R. Gross and P. F. Nichols, who have been conducting work in dehydration at Washington and elsewhere.

The Commercial Insignificance *vs* The National Importance of Coal-Tar Dyes

By Charles H. Stone
Textile Alliance, Inc.

CHARLES H. STONE
Textile Alliance, Inc.

THE number of dollars paid for coal-tar dyes by actual consumers, such as the manufacturers of woolens, cottons, silks, paper, leather, inks, and other users, is so small as to prompt the question: Why is the great amount of publicity and of Congressional time and energy devoted to them?

Immediately prior to the outbreak of the World War, Germany, at that time producing well over 80 per cent. of the 334,000,000 pounds of coal-tar dyes then made annually, doubtless realized fully a hundred million dollars for her yearly production of 295,000,000 pounds. The commercial magnitude of the world's total dye business, then centered in Germany, was comparatively small. The tonnage of dyes used today is considerably smaller than the amount consumed immediately prior to the outbreak of the war, and instead of their manufacture being centralized in Germany, no less than seven nations are now engaged in their production on a substantial scale, although the output in some countries is small, and in a few instances the industry may have fallen under German influence.

The best available information tends to show that the amount of coal-tar dyes now used annually by American consumers is about 60,000,000 pounds of the types as at present delivered, of which the dye factories here are now making slightly more than 90 per cent. As the export business of the American dye manufacturers has fallen off almost to zero as a result of unsettled business conditions and of foreign, especially German, competition, the only substantial outlet left for American-made dyes is the consuming industries of this country.

The 4,000,000 pounds of foreign-made dyes that will be used in our country this year will cost the consumer an average of about $2.00 per pound. The average selling price of American-made dyes during 1921 was 83c per pound, and today is below this average. It, therefore, would appear that this country's annual dye bill is between fifty and fifty-five million dollars, or a per capita cost of from 50c to 55c. Thus we arrive at the commercial insignificance of the dyestuff industry built up in this country during the past eight years. The money-value of our annual consumption of coal-tar dyes is less than double the value of the output of any one of a number of important textile mills, while, for comparison, the annual billings of the General Electric Company average four or more times greater value.

Despite the slight money-value of our dyes, the industry has been taken in hand, to a considerable extent, by organizations whose personnel have looked beyond the dollar value of the business their dye operations would bring in to the potential business offered by the development of related and by-products. And herein we find the key to the commercial, economic, hygenic and military importance of this industry to our nation.

Our consumption, not to mention our waste, of raw materials, has been too prodigal in the past for the welfare of the generations to come after us, therefore any industry that depends upon the conservation and utilization of what we have been wasting, as we have wasted the by-products from our coke industry, deserves to be fostered, if for no other reason than to prevent the waste that heretofore has resulted. The United States is the world's largest producer of coke, about 80 per cent. of which is now produced in by-product coke ovens; and we are told that the by-products are more valuable, measured in dollars, than the main product.

When we consider the hundreds of crudes, intermediates and by-products obtained as a direct result of the production of our fifty million dollars' worth of dyes, we see the commercial value of the total related products of the coal-tar chemical industry trebled or quadrupled. In the case of a few of our larger producers, whose operations start with the coal and stop with a variety of finished products other than dyes, the industry assumes sufficient commercial importance to justify the time and money they have put into it.

The manufacture of commercial products from coal-tar, such as dyes, photographic chemicals, disinfectants, road and roofing materials, together with the special organic chemicals for the rubber, tanning and other industries, has progressed much farther in this country than has the production of pharmaceuticals. The manufacture of pharmaceutical products will certainly be taken up and pressed forward by our manufacturers and chemists interested in coal-tar chemistry even more vigorously than have the other materials, as this field now offers more brilliant and lucrative rewards than any other branch of coal-tar chemistry with which we are today familiar.

It is not a far reach of the imagination to see all of our important medicines synthesized from the products of coal-tar, and as this work goes forward we confidently may expect the discovery and production of coal-tar pharmaceuticals of far greater importance than aspirin or salvarsan, or even all of the pharmaceuticals now obtained from coal-tar, as soon as the time, energy and research are devoted to this branch of the industry by our energetic and resourceful chemists. Neither is it hard to picture the man who discovers the pharmaceutical that conquers cancer and tuberculosis being placed alongside our national celebrities in the Hall of Fame.

Students of the causes which led up to the World War are agreed that Germany's monopoly of the coal-tar chemical industry was one of the chief, if not actually the chief, contributing factor supporting her belief in her ability to conquer the world. Her complete monopoly of the coal-tar chemical industry is now broken. If this industry is not again permitted to be monopolized by any one nation, such a status well may contribute to world security against future wars executed on a grand scale, as the chief nations of the world have learned during the past few years that the products of coal-tar are as essential to successful fighting as are guns and other implements of war.

The continued maintenance and development of the coal-tar chemical industry in America, even if on a scale no larger than is necessary to supply this nation's needs of the products thereof certainly will result in the maintenance and further development of such plants as may be required in the manufacture of military supplies in the next national emergency, and also will support the nucleus of that army of chemical scientists, whose knowledge and training will contribute the chief factors in the winning of future wars.

The science of mathematics has perhaps contributed more to the happiness and welfare of mankind during the past two centuries than any other science. As no one thought or science can continue to dominate indefinitely, are we not now justified in expecting the science of chemistry shortly to succeed the science of mathematics as the chief contributor to the happiness and welfare of mankind? May we not further rightly conclude that organic chemistry, with its myriad materials awaiting conversion, will become the dominant factor in the future progress of mankind?

As we enter this era may we not expect America, whose energy and resourcefulness have created more than one constructive era in the world's progress, to take her accustomed place of leadership in this science, which is to contribute so generously in giving man full mastery over those elements and conditions that have heretofore defied him, thus carrying us on to that stage wherein the unrevealed will be only those phenomena that the Creator, who put Rhodamine in coal-tar, has preordained shall remain sealed to us for all time?

Industrial Chemicals During the Past Year

By Guy A. Gardner

Manager, Chemical Department, M. Gottesman & Co., Inc.

THE past twelve months in the industrial chemical market have been a period of changing conditions that one way and another has kept both manufacturer and consumer on the anxious seat. On the whole, during the last six months of 1921 and at least the first six months of this year, the trend of prices has been consistently towards lower levels, with values becoming increasingly in the buyer's favor, except in relatively few instances where production has been so greatly reduced as to somewhat keep pace with the slow demand.

Many untoward developments during the year have tended to set back the recovery to more normal conditions that everyone has been expecting for many months. Labor disturbances in the textile, paper and glass industries, together with the coal and railroad strikes, have greatly retarded production in many important lines of manufacture using large quantities of chemicals. The lack of an active and consistent demand forced manufacturers in many lines to cut prices so far that production costs practically were disregarded in an endeavor to keep their plants working and their various organizations intact. Some months ago these very low prices were supposed to be based on replacement value, and everyone believed that these lower replacement costs were possible, but in the case of most chemical manufacturers they never happened. The high freight rates, strikes, heavy overhead charges on low volume production, and the consistently high price of labor, kept the costs as high as ever.

The slump in the export demand for chemicals was on a par with the conditions in the domestic market, and the decrease, according to Government statistics for the past twelve months, was practically fifty per cent. This was due very largely to the extremely uncertain fluctuations in foreign exchange, which prevented a satisfactory export business being done in practically all lines of chemicals. The general depression and the liquidation of industry which have been taking place all over the world also greatly lessened our chemical exports. The depreciation of foreign currency resulted in a heavy importation of various chemical products at prices which no American manufacturer could profitably meet, and while this condition was largely a temporary one, it resulted in forcing still lower the price of many chemicals largely used in our various industries.

It has been a generally accepted theory that any discussion of a change in the tariff tends to unsettle the market, and it has been especially noticeable this time. However, it may be expected that the new tariff will go into effect by the end of the year, and we hope that the proposed changes will have the stabilizing effect on the chemical market which many predict.

While the tremendous decline in foreign exchange, particularly in Central Europe, enabled the foreign manufacturers to quote ruinously low prices, the continued depression of the currency has tended to act as a boomerang, compelling the foreign sellers to quote on a basis of the American dollar or practically to offer on an open price, subject to change when the goods were shipped, owing to the very rapid fluctuation in the exchange rate. The long continued depression of their currency also has had a demoralizing effect both on capital and labor abroad, cutting down production and destroying initiative in almost every line of endeavor, so that it is hardly likely that they can continue to supply chemicals of good quality at the very low prices they have been quoting during the past year. We also may expect that the dumping process will be further curtailed by the increased duty.

Shipments from abroad are at best uncertain and the quality of many importations has been very widely questioned. Even the attractive prices recently quoted were evidently not a sufficient incentive to induce importers to take chances, particularly as many of the foreign contracts are so worded that little dependence can be placed upon their price, quality or delivery.

During the past year, the many difficulties confronting the chemical manufacturer and the uncertainty of the future developments, brought about conditions which led to a decidedly panicky market and a feeling of pessimism undoubtedly prevailed, causing prices to decline below a reasonable figure and utterly destroyed the confidence of the consumer, who very naturally felt that he could not purchase on anything like a sound basis. The past month or two, however, has developed a decidedly better feeling in all branches of the chemical industry. Everyone seems to think that we have turned the corner, and that from now on a better and more stable market can be expected.

In spite of the many troubles still confronting us, there is a much more confident attitude expressed by both sellers and buyers, and this change has come about during the summer months, when usually we expect a seasonable slowness of demand and a consequent weakening of market prices. Buyers are beginning to realize that present manufacturing costs are here to stay for a while at any rate, and they naturally cannot expect the manufacturer to continue to sell his product at less than the cost of production, and they are buying for forward delivery in greatly increased volume. The increasing demand which has developed in the last two or three months has given a much firmer feeling to the market. Sellers are much less disposed to cut prices, and in many cases the prices have been advanced in line with conditions, and the movement towards higher price levels may be looked for all along the line.

There seems to be no doubt of a great improvement in the condition of the market compared with only a few months ago, and every indication would seem to point towards a steady return to at least normally good business for the coming year. The soft coal strike is now settled, and the outlook for a speedy settlement of the hard coal strike is very favorable. The railroad situation still seems uncertain, but there can hardly be a doubt that this, too, will be adjusted in the very near future. The textile strike is over and the mills are getting back to full production as quickly as possible, although it will no doubt take some little time for them to get production back to a normal basis. Many of our other leading industries are now working at practically full capacity, and the demand for chemicals will, of course, be greatly benefited by this general resumption of activity.

The greatly curtailed production of many chemicals during the past year makes it evident that stocks on hand will be small, and with the larger demand there is a prospect that a shortage of supplies may be developed in many chemicals that are used in large quantities by the various industries. This condition will naturally call for a greatly increased production and may result in considerably higher prices. Although the coal mines have resumed operations, it will be some time before coal will again be plentiful, and this shortage of fuel will no doubt prevent full production in some lines. A higher price for coal inevitably means a higher cost in the production of most industrial chemicals, and this condition must be seriously considered during the coming months. Many of the leading items are being sold to-day at prices that appear to offer every inducement to the buyer to cover his requirements for the coming year on a safe basis, and, from all reports, buyers are realizing this and are welcoming the change as a pleasing contrast to conditions prevailing during the past twelve months.

Everything considered, the chemical industry has just passed through a very trying year, and the manufacturers are to be greatly complimented on the excellent showing which they made in the face of many trying conditions. There can be no doubt that the chemical industry, with its greatly increased capacity, is now in a splendid position to take care of the consumers' requirements in every line. With the improvement of conditions so general, the prospects for the coming year look bright indeed.

Ethyl Alcohol from Western Larch

Experimental fermentations of sugars obtained from western larch indicate that this wood is one of the most valuable sources of ethyl alcohol. By a careful regulation of temperature and acidity and by finding the proper yeast the U. S. Forest Products Laboratory, Madison, Wis., has succeeded in converting into alcohol not only the sugars obtained from a hydrolysis of the cellulose but also a large proportion of the galactose sugar obtained from the galactan in the wood. The yeast used in the laboratory experiments was a pure strain culture of Hungarian beer yeast which has proved very efficient in the fermentation of sugars resulting from the hydrolysis of wood. In fermenting solutions containing galactose the temperature was held between 85° and 90° F., and care was taken that the initial acidity of the solution was under 5 degrees.

The galactose fermented better alone than when mixed with the other sugars, probably because the acid formed by the other sugars prohibited the yeast from fermenting the galactose. Even when the galactose and sugars obtained from the cellulose were fermented together, however, the total alcohol yield from western larch was found to be at least 33 gallons per ton of dry wood, or almost 10 gallons per ton greater than that of any other wood studied. The production of ethyl alcohol from any source is of particular importance in view of the impending shortage of motor fuel; and the fact that western larch is so productive a source of this material is of especial interest to the lumber industry since it affords a means of utilizing not only the waste but also the large quantities of butt logs of high galactan content now left in the woods. The paper industry should also be interested in the fact that galactose from larch can be fermented, for by extracting galactan from larch chips before pulping, a quantity of sugar easily converted into ethyl alcohol can be obtained.

The Dexter Helium Co. of America, Winfield, Kan., M. W. Baden, president, has plans in progress for a helium recovery plant at Dexter, Kan., estimated to cost about $1,000,000.

* * *

The Government helium plant at Fort Worth, Texas, will be put in operation September 1, at which time the Congressional appropriation of $800,000 for this purpose will be available. Investment in plant, experimental station and pipe line to the Petrolia, Texas, natural gas field aggregates $2,000,000.

* * *

It is reported that negotiations looking to the consolidation of Armour & Co. and Wilson & Co. are under way. Nothing has been decided, it is said, and no prediction can be made, as such merger must have the consent of courts, Department of Agriculture and Department of Justice.

* * *

Salt Lake Insecticide Co., Salt Lake City, Utah, has acquired the process recently developed by Dr. Frank K. Cameron for the manufacture of calcium arsenate from the scorodite ores of the Western Utah Copper Co., and has been erecting a plant at Salt Lake City, of which Dr. Cameron will be general manager.

Chemical Industry on the Newark Meadows

By Philip DeWolf
Industrial Engineer, Louis Schlesinger, Inc.

WHEN the average chemical student comes out of college and "accepts" his first "position," one big thought overshadows everything else—it is a chemical plant, and a knowledge of chemistry is the only really important knowledge. Of course, the cashier is useful on Saturday; the trucking boss sends for his suitcase when he comes back from his vacation; and even the salesmen are nice fellows who seem to earn plenty of money, so they probably have some value to the company.

As time goes on and he "gets a job," he realizes that the office force has an importance he never dreamed of. After a week of bitter cold and snow, when he is working twenty hours a day to keep the furnace running, making three hours' normal supply of pyrites do for a day, he begins to see that the transportation department helps things to run smoothly; and as he watches his company grow, while his salary goes up too, and while the Smith Company, which he knows makes just as good soap or baking powder, lets its buildings run down, and his friends who work for Smith are constantly wondering how long their jobs will last, he at last sees the light—sees that if you can't sell what you make, you can't stay in business.

A glance through the telephone "Red Book" of any large city will give some idea of the tremendous chemical business that is necessary for carrying on ordinary activities. Start on the first page—the first classification is "Abdominal Belts"—all the materials necessary for their manufacture can be made up in plants convenient to raw materials, and the cotton webbing, leather, rubber, thread, etc., can be shipped in large quantities to warehouses. Such materials keep any length of time without deterioration.

The second item is "Abrasives". That includes sandpaper, made up of paper, glue and sand. The first and third items stand shipping and storage. If the glue is an animal glue it must be made where dead animals are available, and that is near a city. I think it is safe to call a dead horse "perishable freight", and I am afraid one would have difficulty in getting a railroad to accept carloads of such material regularly.

Laundries, foundries, plumbers, druggists, photographers, printers, electroplaters, painters, engravers, jewelers, and other trades too numerous to mention, use sulphuric acid in small quantities. It has to come to them by truck, but it has to come from somewhere. Acid of 50° or 60° won't stand much of a freight charge, and rates on it are high, as an accident to the car might mean much more trouble and expense to the railroad than as bad a wreck of a carload of brick. The logical thing is to bring in the low freight sulphur to a place as near the market as possible, and there make the high freight acid, for the other ingredients, air and water, cost about the same anywhere.

The business in heavy chemicals in a big city is very large in the aggregate, but is made up of many small items. It is a retail trade, and like most retail business must give delivery to the customer. Such deliveries are invariably made to-day by motor truck, and the expense of that trucking is a big item. The seller with the most economical distribution has a big advantage.

High priced goods can pay high priced storage. The item of storage is a very small one on a hundred thousand dollar pearl necklace in a Fifth Avenue jeweler's vault, even with Fifth Avenue rents what they are. An eighty dollar suit of clothes must allow for its share of the rent on Forty-fourth Street. A pound of 33-cent coffee has a very definite charge against it for storage. With 50° acid as low as three-eighths of a cent a pound, and its storage in any quantity absolutely prohibited in some sections and hedged about with restrictions in others, the matter of a point for distribution is not an easy one to solve.

New York is fortunate in having the solution of that problem very much simplified for her, because the Newark meadows might have been designed by Nature for chemical manufacture, and wise laws have helped the development. They run from Hackensack on the north to Perth Amboy on the south, a distance of over twenty-five miles, and from nothing to over five miles wide. The southern half borders on the deep water of Newark Bay and the Arthur Kill, giving direct access to the Atlantic Ocean. The navigable waters of the Hackensack, Passaic and Rahway Rivers cut across, and the Central Railroad of New Jersey, Pennsylvania, Lehigh Valley, Lackawanna, Erie, and the Susquehanna, all tied together by connecting lines, also cross and serve this territory.

Some of this territory is within five miles of Broadway and 42d Street, and the big bulk of it within ten. Good roads, without hills, lead in straight lines to the ferries across the Hudson, and to where in a few years the vehicular tunnel will afford an approach without ferrying to Manhattan.

While thinking of the nearness of this ideal chemical manufacturing area to New York, don't forget that to the north and west, and nearer to it than to New York, are Newark, with half a million people, and Paterson, one of the silk manufacturing centers of the world, and along every railroad are towns and industries using chemicals every day. Jersey City, between the meadows and New York, is a hive of industry. The manufacturers already located on the meadows use a lot of chemicals.

The water supply is that of the cities of Newark and Jersey City, which is abundant and good.

So many factors enter into the choice of a location that to say any one is the most important is like entering the old query: "Which is the most important leg of a three-legged stool?". A satisfactory labor market is as important as any other factor, and the labor conditions in this Newark Meadows area are all that could be desired. The population of Newark, Jersey City, Paterson, Bayonne, Hoboken, Elizabeth, and the other cities that border this area, is composed of workers, skilled and unskilled, for a wide diversity of industry. Textiles, metal working, heavy construction, leather, and most branches of the chemical industry, are now employing many people, and it is prob-

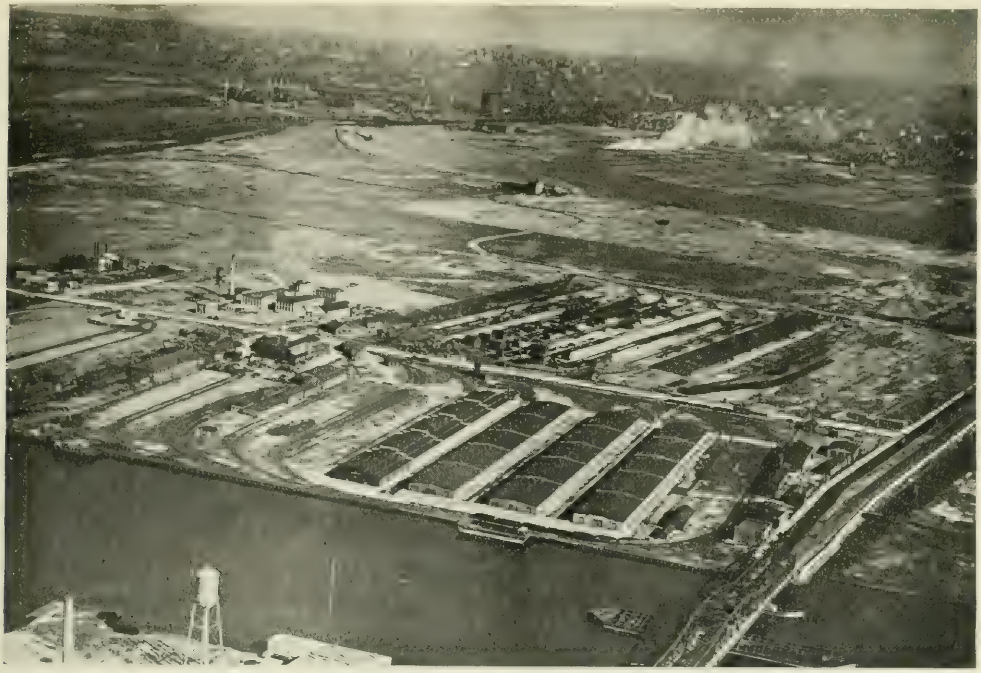


Fig. 1. Shupe Terminal with the skyscrapers of Manhattan on the horizon.

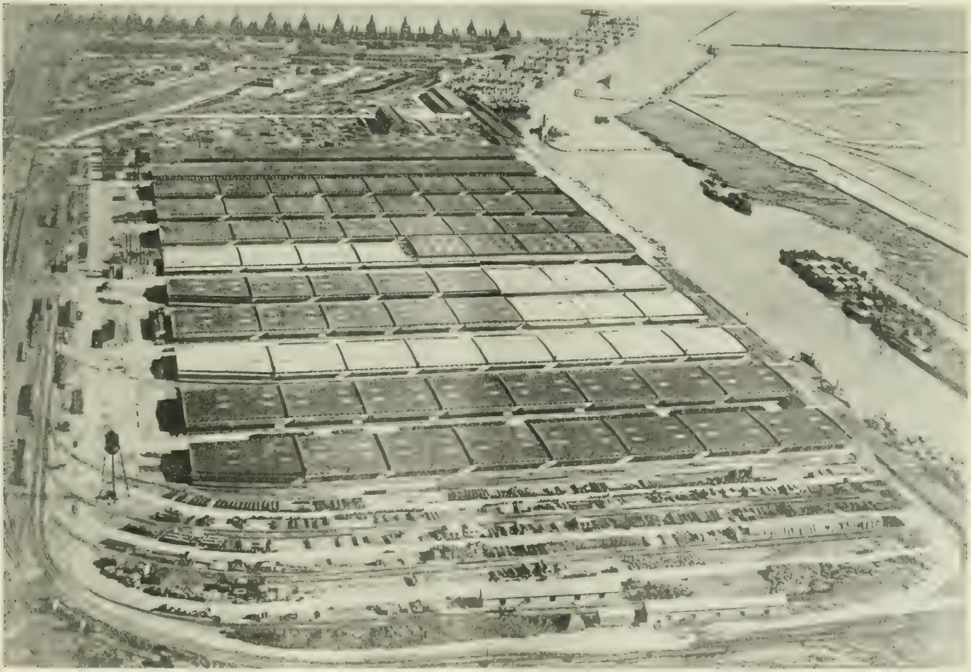


Fig. 2. Municipal Warehouses, Port Newark, Newark, N. J.

Photos by Fairchild Aerial Camera Corp.

able that labor experienced in any department of industry can be recruited here. Newark boasts of three hundred different industries.

Transportation is so good, and housing so well distributed around the outside of the area that labor is readily available at every point.

While living conditions are good there now, they will be much improved within the immediate future. The Pennsylvania Railroad is establishing a perishable freight terminal, where all the fruit and garden truck shipped over the Pennsylvania lines to New York will be distributed. This terminal is on the meadows. This means that the surrounding population is going to have first chance at food coming in on consignment, and as handling plays a very important part in the cost of food, prices are sure to be low. The establishment of this terminal here also shows that, in the judgment of the Pennsylvania, this is the best available spot for truck distribution to New York City.

Plants that wish to buy power are splendidly served by the Public Service Corporation, whose power lines cover the area. Trolley service is also supplied by this Corporation. One of their power houses show up well in Fig. 1.

Going back to the Red Book we find that materials such as cotton, rubber, paper and sand must be stored. The Shupe Terminal, shown in Fig. 1, and the warehouses taken over by the City of Newark, at Port Newark, in Fig. 2, provide storage facilities for small or large quantities with docks on deep water, and railroad sidings that connect all over the North American continent.

There is an opportunity open now such as rarely presents itself, for the establishment of a cold storage plant to serve this district. When a shipment of fruit comes in to the new Pennsylvania Terminal and is not sold at once, it must be stored, and at present there is no cold storage available short of Newark. Someone is going to buy a piece of land right along side of the terminal, put up a cold storage warehouse, and make some money.

A list of the industries now located on the meadows reads like an industrial directory of the nation. Among the larger plants already established are:

American Agricultural Chemical Co.
American Splint Co.
Atlantic Smelting & Refining Co.
Baker Cocoanut Co.
Balbach Smelting & Refining Co.
Butterworth-Judson Co.
C. W. H. Carter & Co., Inc.
Celluloid Co.
Colgate & Co.
Columbus Crystal Co.
Martin Dennis Co.
Dye Products & Chem. Co.
Egyptian Lacquer Mfg. Co.
Thomas Edison Co.
Federal Shipbuilding Co.
Ford Motor Co.
A. Gross & Co.
Heller & Mertz Co.
Indian Refining Co.
Ladew Leather Works
Niles-Bement Pond Co.
Organic Salt & Acid Co.
Prest-O-Lite Co.
James H. Rhodes Co.
Schofield Oil Co.
Seabord By-Products Coke Co.
Mutual Chemical Co. of America
Submarine Boat Corporation
Sun Oil Co.
Tanners' Products Co.
Texas Oil Co.
Tower Manufacturing Co.
White Tar Co. of N. J.
Standard Chemical Co.
North American Copper Co.
Oil Seeds Co.
Gulf Refining Co.
Pacific Coast Borax Co.
International Smelting Co.

The Newark Meadows is dotted with vacant plants, built for war purposes, and now that their original function has been fulfilled are idle. Most of them are of modern construction, in as good condition as new, some with full equipment, some just the buildings. Most of these plants are for sale or rent, and real bargains are to be found.

It is probable that manufacturers of light machine products, and of organic chemicals, can find plants ready to move into, as well adapted to their use as though they had been built for them. One plant, devoted to turning out sights for artillery, is now awaiting a manufacturer needing a machine shop to turn out high class work, the market for sights having fallen off. The many small plants making drugs in large quantities during the war, but for which there is no sale today, are available for dyestuff manufacture.

The accompanying illustrations show, Figs. 1, 2, 3 and 4, as no words can, the splendid transportation and storage facilities available. Also, Figs. 1 and 3 show how close to work the housing is. In Fig. 1 the Woolworth Tower in New York can be seen a little to the right of the center, and to the left of the center towards the top are shown the five stacks of the Public Service Corporation's large power house. Fig. 4 shows how diverse are the industries, which are mutual customers that are grouped in this area, and also shows the Lincoln Highway running across the picture.

The work of the Port Authority of New Jersey and New York has just begun. The responsible heads are men of outstanding ability, and the comprehensive plan on which they are working will make the already good shipping facilities even better.

The effect of the Free Port law upon some lines will be very marked. We are all familiar with the practice of the sugar refineries, bringing in Cuban sugar under bond, and shipping it out for export. By doing this they save tying up a lot of money in customs duties, and the discouragements and worries of getting the "drawback" when the sugar is exported. But that is all done in one plant—the same privilege will be extended to the entire Free Port area. What that means is that raw or semi-manufactured material can come in and go through not one process, but any number of processes, in several plants if necessary, and then be exported without tying up a lot of money in duties. It is this that has made Hamburg one of the great ports of the world.

Fertilizer and soap making and copper smelting, to mention a few industries that are barred from many districts, are carried on in this Newark Meadows on a large scale, and the investment is so enormous that it is incredible that any restrictive laws should be made to apply here. This unique area, favored by nature and by man, is destined to be one of the greatest chemical manufacturing centers of the world.

Prof. A. H. Espenshade, registrar, Pennsylvania State College, sets forth the danger of "scholastic stomach ache" in a college which admits students which he classifies as "unripe fruit." Personal letters now required from all applicants for admission to that institution enable a distinction between men and women "who want to come to college and those who are being sent to college."

"If you place five bad apples with twenty sound apples," said Prof. Espenshade, "the bad apples do not get sound. The good apples become bad." In a student body, he added, a few poor students infect those with whom they come in contact and subtract from the sum total of earnestness.

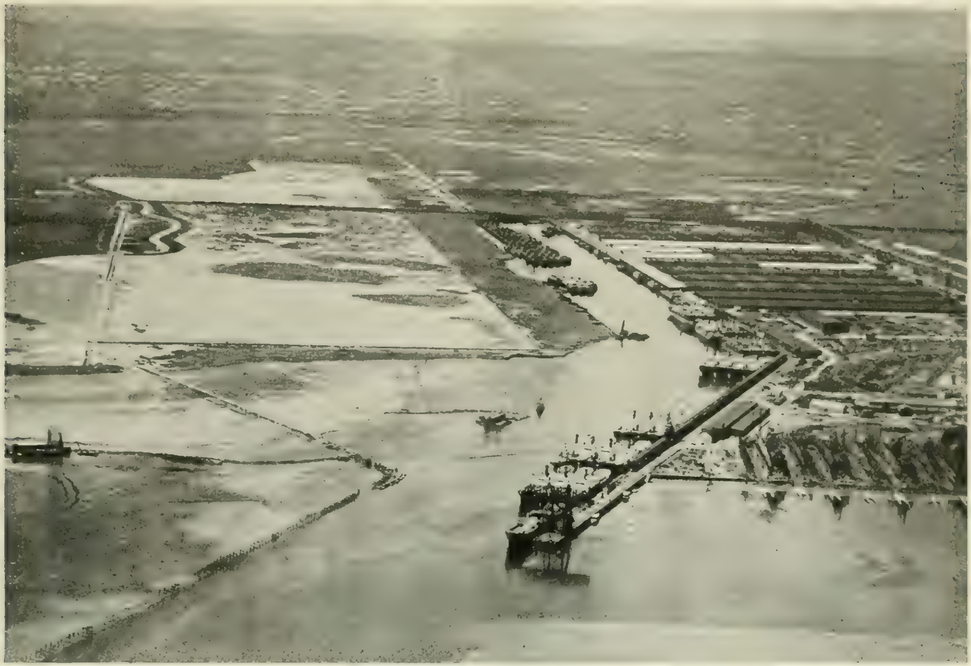


Fig. 3. Entrance to Port Newark, Newark, N. J.

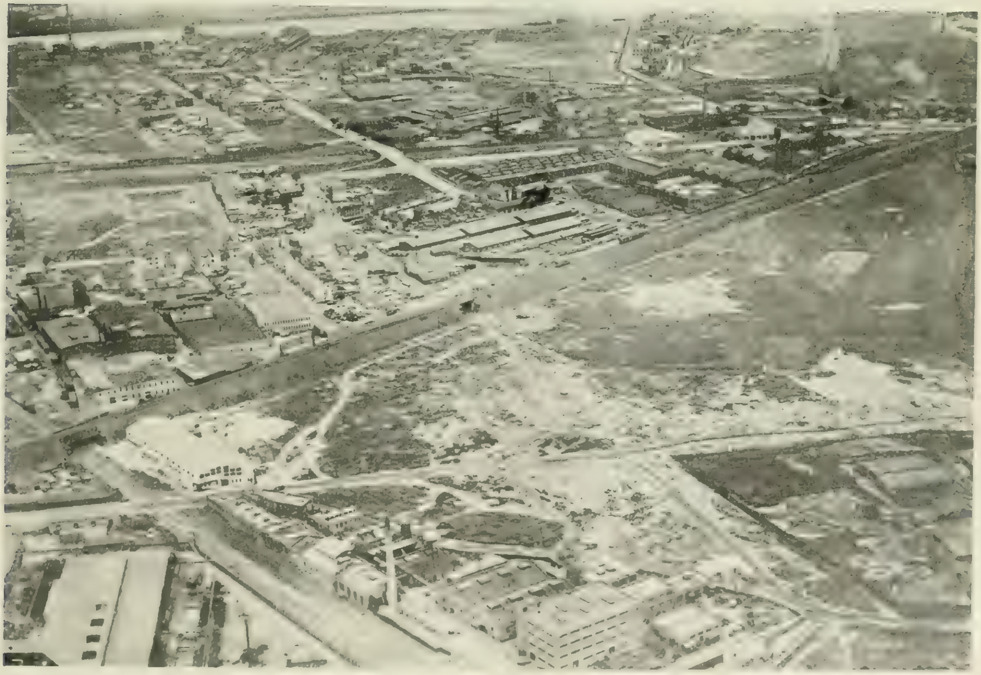


Fig. 4. View of plants of Sherwin Williams Co., U. S. Industrial Alcohol Co., Central Dyestuffs & Chemical Co., showing the diversification of industry

[illegible]

The American Institute of Chemical Engineers

A Summary of Its Accomplishments in the Establishment of the Professional Status of the Chemical Engineer and a Statement of Its Influence in the Promotion of Chemical Engineering Education and Chemical Industry

By Dr. John C. Olsen

Secretary, American Institute of Chemical Engineers

A HUMAN organization or institution should be able to show that it serves some useful purpose in society. If it cannot do so it should be disbanded. Undoubtedly Dr. Osler's suggestion that a man should be chloroformed after he has passed the age of usefulness might be applied often with profit to institutions which have outlived their usefulness. Respectable or even honored ancestry should not be made to serve as an execuse for present day inactivity. The question proposed by the editor of CHEMICAL AGE, "What Has the American Institute of Chemical Engineers Accomplished?" certainly deserves an answer.

Richard K. Meade, in an article in the July, 1919, issue of CHEMICAL AGE has given an excellent account of the extended discussion which preceded the organization of the American Institute of Chemical Engineers. The objects sought by the organizers were so clearly set forth in that discussion that very little change has been found necessary in the constitution or methods of operation of the Institute. The most prominent of the purposes of the organizers was recognition of Chemical Engineering as a profession and raising ethical standards among chemists.

DR. JOHN C. OLSEN
Secretary American Institute of Chemical Engineers

Strictly Professional Societies Are Necessary

As human society is organized the establishment of a profession is of very great importance. The public must not only recognize the special qualifications which constitute a Physician, for instance, but the members of this profession must be conscious of certain very clearly defined obligations to the public and of limitations upon personal conduct. It was vital to the development of chemical industry that the special qualifications which enables a man successfully to design, construct or operate chemical plants should be clearly set forth and recognized by business men and the public in general. There were and still are many who have been trained as chemists who do not recognize the existence of the chemical engineer as distinguished from chemists generally.

Quibble Over the Difficulty of Distinguishing the Practitioner

One objection strongly urged against forming an organization of chemical engineers was that it would be found impossible to define chemical engineering or make an intelligent distinction among applicants for membership. The anticipated insuperable difficulties have not materialized. Under the able leadership of Dr. Arthur C. Langmuir the Membership Committee has generally found very clearly marked characteristics by which the designing, the constructing, or the operating chemical engineer can be differentiated from the analytical, research or other class of chemist.

It was inevitable that there should be individual cases where education or experience was such that it was found difficult to draw the line. Such cases have not been found numerous. That the distinction is not an imaginary one is shown by the frequently heard remark by those who attend meetings of the Institute that its membership, its programs and discussions are distinctly different from those of other chemical societies. Educational authorities by this time have generally recognized the chemical engineering profession by the introduction of chemical engineering courses in all the leading universities and technical schools.

Standardization of Chemical Engineering Education

Having established the process of selection of the chemical engineer by an examination of a man's education and practical experience and success, it was a logical step that the Institute should devote some of its energies to a study of chemical engineering education in universities and technical schools. A committee on this subject was appointed at the first meeting of the Institute. Reports have since been made by this Committee semi-annually. Some of these have been very extensive and taken together constitute probably the most important contribution to the literature on this subject.

The last report rendered by the Committee under the chairmanship of Dr. Arthur D. Little showed a truly astonishing lack of uniformity in the courses prescribed by the various schools offering courses in chemical engineering. It is evident that there has been very little cooperation or discussion by those drafting these courses. The result has been wide variations in the training and qualifications of the chemical engineering graduate and what is still more serious, he has been in many cases very poorly qualified by education for his professional work. This situation has no doubt arisen from the fact that there has been no organization which could take the initiative and leadership in bringing about uniformity and raising the standard in the educational institutions.

The American Institute of Chemical Engineers occupies an excellent strategic position from which it can, with fair prospects of success, exert its influence to bring about greater uniformity and improvement in the courses offered. As the membership of the Institute is composed very largely of chemical engineers occupying responsible positions, who must employ the young graduate chemical engineer and observe his success or failure, the opinion of the members of the Institute as to the results of educational processes must be excellent. The various reports of the Committee on Chemical Engineering Education have expressed the judgment of the Institute on many phases of chemical engineering education.

A new committee soon will be appointed which will attempt by cooperation with educational authorities to secure modification of existing courses in order to bring them into closer harmony with the views of the Institute. An attempt also will be made to prepare a list of the universities and colleges which offer approved courses in chemical engineering. The work of this committee undoubtedly will lead to substantial improvements in educational methods which in turn will increase the efficiency and success of the chemical engineering graduates. The American chemical industry will profit greatly by an advance in this direction. The improvement in the quality of the graduates of chemical courses since the introduction of courses in chemical engineering has been very marked during the last decade or two. It may confidently be expected that quite as marked an improvement will be shown as the result of the improvement and standardization of chemical engineering courses.

Code of Ethics

Another activity of the Institute which is of quite as great importance as the educational qualifications of chemical engineers, is concerned with the ethical questions peculiar to the profession. These, broadly speaking, may be considered from two points of view. One of these concerns the character of the individual chemical engineer; the other involves the ownership of patent rights, chemical processes and methods. The personal honesty and trustworthiness of the individual chemical engineer is of the greatest importance on account of the confidential information of great value which he often has in his possession. On the other hand it is equally vital to the welfare of the profession in general as well as to the individual chemical engineer that he should understand clearly his own property rights in this confidential information and the processes which he may develop. While the general principle is well recognized that every man is the rightful owner of the product of his own labor, whether physical or mental, when other men have cooperated with him the determination of ownership is not always a simple matter.

In drafting a Code of Ethics, the American Institute of Chemical Engineers has endeavored to state the principles governing these and other questions of ethics which arise in chemical engineering work. That the Code was carefully drafted is indicated by the fact that no amendments have been found necessary. The enforcement of the Code insofar as the members of the Institute is concerned, is in the hands of the Membership Committee and the Committee on Ethics. In passing on the qualification of new members, the Membership Committee must assure itself that the conduct of each candidate for membership is in accordance with the Code of Ethics. Candidates for membership are, at times, denied admission to the Institute on this account as well as because of lack of educational requirements and successful experience in chemical engineering work. Infractions of the Code of Ethics by members are taken care of by the Committee on Ethics. The fact that no case of this kind has arisen indicates that the Membership Committee has done its work with great care.

The opportunity to visit chemical factories has often been accorded to the Institute as a body on account of its Code of Ethics and the rule by which every member of the Institute pledges himself not to visit a plant in the same line of manufacture as his own without declaring this fact to the management and offering the same privilege of visiting his own plant.

No direct means have been found for enforcing the principles of the Code of Ethics on non-members of the Institute. It is believed, however, that the indirect influence toward raising the ethical standards of the chemical engineering profession has been considerable, and that this influence will increase with the growth of the Institute, and that its Code of Ethics will be accepted more and more as the expression of the recognized ethics of the profession.

The Transactions

Another important contribution of the Institute to chemical industry has been the publication of papers on chemical engineering topics. This has been accomplished by offering a hearing and opportunity for discussion at the meetings of the Institute to chemical engineers, whether members of the Institute or not, who are ready to present papers on chemical engineering subjects. An opportunity is afforded in this way to present such papers before a group of experts whose criticism is of great value. Papers on other phases of chemistry have not been accepted for reading or discussion. Papers read, with the discussion, have been published in bound volumes of transactions published annually or semi-annually. These volumes contain a very valuable collection of papers on a great variety of chemical engineering subjects. A large number of these papers also are published in various trade journals, thus giving wide publicity to the subjects presented and to the authors.

General Activities

The Institute has endeavored to influence legislation along lines favorable to the chemical industry through its Committees on patents, on the metric system, licensing of engineers and on other matters as occasion has arisen. When the Federated American Engineering Society was organized, the American Institute of Chemical Engineers became a member of this society, and in this way has supported this organization in its endeavor to make the influence of the technical man felt in national and state affairs. This influence has no doubt been of very great benefit to the nation as well as to the engineering profession.

The American Institute of Chemical Engineers is the only national chemical society which is represented in this organization. The influence of the trained engineer in our national and civic life will undoubtedly increase very greatly in the near future and it is of great importance that the chemical engineer should contribute his share to this important movement.

The Engineering Professions

The increasing appreciation of the importance of the engineering professions is shown by the very rapid increase in enrollment of engineering students at our universities and technical schools. The large number of technically trained college graduates will serve not only to fill the increasingly numerous positions of responsibility in our industrial establishments, but also will furnish for public service, men who have had the exact training of the technical professions. Legislation with reference to our industrial problems undoubtedly will be favorably influenced by this change in the character of our public men.

Social By-Products

A very pleasing feature of the meetings of the American Institute of Chemical Engineers, which cannot be said to have been anticipated by the founders of the society, has been the close personal friendships which have arisen between a great many of the members as well as in many cases members of their families. This undoubtedly has been made possible by the careful selection of members, the relatively small membership and the large percentage of members who attend each meeting.

This personal acquaintanceship no doubt has made the meetings more pleasant socially as well as more profitable professionally. While the percentage of the total membership in attendance at meetings is large, the total number has not been large enough to make the meetings unwieldy. It has been possible, therefore, to hold meetings in relatively small cities particularly where some interesting chemical engineering development could be seen and studied.

Membership Growth

Considerable discussion has arisen at times as to whether it is desirable for this society to grow until its membership has reached many thousands. Undoubtedly many of the advantages of a small group of well-acquainted members would then be lost. Efforts have been made to amend the constitution so as to provide for more grades of membership in order to secure a more rapid growth in membership. All such propositions have been voted down. The present membership is, therefore, convinced that the advantages of a relatively small society of carefully restricted membership outweigh the advantages of a large society of less closely affiliated members.

The Trend of Chemical Segregation

The general tendency in the chemical profession seems to be to maintain a number of smaller societies composed of specialists in a well-defined division of chemistry, with the rapid increase in specialized knowledge in every branch of chemical research. This tendency will, no doubt, become more and more accentuated. The formation in a large general society of divisions of such specialists seems not to have fully satisfied their professional requirements as well as such an organization as the American Institute of Chemical Engineers.

The necessity arises at times for action by the entire body of chemists of all classes. The need might well be met by an organization such as the Federated American Engineering Society. The various chemical societies have on a number of occasions shown the inclination and the ability to cooperate when common action seemed necessary.

It is to be anticipated that the American Institute of Chemical Engineers will continue to grow in membership with the expansion of chemical industry. The qualifications prescribed by its constitution are the only limitations upon its growth in membership and there are undoubtedly many chemical engineers fully qualified for membership who are not at present members. The present membership is firmly convinced that the maintainance of these qualifications is necessary in order that the [illegible] of the Institute shall continue [illegible]. It has been criticised for being too exclusive, but specialists in other branches of chemistry have the same opportunities to organize and establish similar professional standards.

Standardization of Chemical Equipment

The Institute will, no doubt, undertake new activities as their desirability becomes evident. One line of professional work for which there seems to be a necessity is the preparation of standard specifications for chemical engineering apparatus. Those which have so far been made seem to have been formulated by men who were not chemical engineers, and in some cases were prepared for entirely different purposes or uses than those which the chemical engineer has in mind. The drafting of such specifications can be satisfactorily made only by a body of specialists organized as a professional society such as the American Institute of Chemical Engineers.

Government Cooperation with Chemical Industry

Following the establishment of the chemical division of the Bureau of Foreign and Domestic Commerce and the appointment of Carl R. DeLong, formerly of the U. S. Tariff Commission as head, comes the appointment by Secretary of Commerce Hoover of an advisory committee in the field of heavy chemical manufacture. The duties of the committee will be to consult with Mr. DeLong, regarding the manner in which the new division can best serve the industry in promoting the export trade in heavy chemicals.

The committee compromises: Chairman, Henry Howard, Grasselli Chemical Co., Cleveland; S. W. Wilder, Merrimac Chemical Co., Boston; E. M. Allen, president Mathieson Alkali Works, New York; Robert T. Baldwin, National Aniline & Chemical Co., New York; Dr. Charles L. Reese, E. I. du Pont de Nemours & Co., Wilmington; A. G. Rosengarten, Powers, Weightman & Rosengarten, Philadelphia; Lancaster Morgan, General Chemical Co., New York, and H. H. Dow, Dow Chemical Co., Dow, Mich.

At the initial conference Aug. 30, the general question of foreign trade in heavy chemicals was discussed by Mr. Hoover, who with Mr. DeLong and Dr. Julius H. Klein, director of the Bureau of Foreign and Domestic Commerce, explained to the chemical men the facilities of the Department of Commerce, and the efforts being made to promote foreign trade. Mr. Hoover declared that the new chemical division is willing to assist the industry in any way they suggest, and pointed out that the extent of service rendered will be measured by the co-operation extended by the industry.

What is going to happen in industry in the next ten or twenty years, following the great upheaval in the human mind in the war we have been through? There is going to be a chemical development in industry as great as the mechanical development. The man who does not get his plant under chemical control is going to be left behind. Now, to get your plant under chemical control is not a difficult thing. It does not require a college education but it does require brains. A college education is not brains; it is an index to knowledge, but a lot of men have that index and do not know how to use it. A lot of men who do not have a college education have brains.

What you want in your mills to get advantage of this great wave of chemical development, is to keep the chemist under your control. Put your young chemist in the laboratory and tell him what you want and make him produce it. He can do it, but you will find your chemist has no imagination. Tell him what you want to find out, the wastes there are that you want to [illegible], and he can do it for you. That is practical chemical control.—*[illegible], president [illegible] man Co., Chicago, Ill.*

Dr. Charles Frederick Chandler

"The Grand Old Man of American Chemistry"

Born in Roxbury, Mass., December 6th, 1836, the approach of his 86th birthday finds Dr. Chandler in service as Technical Advisor, The Chemical Foundation, Inc., and as keenly alert to the needs and possibilities of American Chemistry as when as a boy he went from Harvard to Göttingen; as when at 21, in '57, he "doubled" as instructor and janitor at Union College; as when in '64 he went to Columbia where until 1911 he personified the progress of chemical science and art in America. Honored beyond all other chemists, to Dr. Chandler has been granted a perspective shared by no other member of his tribe and who in universal affection is addressed as

"The Patriarch of Chemical Progress in American Industry

Than whom, among chemists, there is no one more beloved, no one more graced with kindly sympathy, no one more potent to inspire, in all America."

CHEMICAL AGE

Volume 30
Number 9

September
1922

A Consolidation of
The Chemical Engineer
and Chemical Age

EDITORIAL

THOUGHTFUL men seen in the present trend of events in industry the earmarks of the inflation that marked the illusory prosperity of the war and post-war periods. With deflation run its course in capital and the products of the soil, ere it had begun in labor save as it had been enforced by the compulsion of idleness through inability to buy, now resistance on the part of labor to the play of economic law is meeting with such measure of success that trite is the comparison between current conditions, with the labor supply throttled by class legislation, with those prevailing when, with four millions under arms, organized labor capitalized our country's peril and the cowardice of politicians to make itself a favored class.

We would not minimize the necessity of selection of immigrants that the work of Americanization may be hastened and made thorough, but we would magnify the unscientific character of our immigration laws and the penalty that the people pay for the ineptitude of politicians in permitting organized labor to make our common government an instrument of class ends.

With the unparalleled consumption capacity of America, after prolonged self-denial, now seeking a measure of satisfaction, labor by its premediated and inevitable scarcity obtains that which management can pass on to the people in higher prices for the essentials of life. The result cannot be other than the vicious cycle of pyramided costs that only yesterday palsied the power to pay.

America needs today as much as in more primitive days the stalwart breed to transform into the structure of the nation the fixed capital of her progress. If we are to be denied the essential services of the hewers of wood and the drawers of water that their descendants may profit by their absence to levy tribute on the masses in increased costs that contradict their fancied gain, the spirit of American institutions unmistakably has begun to wane and wither.

WITH the National Exposition of Chemical Indistries as one of the most effective educational agencies in chemistry, the glorification of the salesman as a teacher is natural. Here the business chemist has assembled the raw materials and creations of the production chemist, and the engineer the equipment essential to their manufacture. Here the business chemist properly is the "master of the show," just as should be the teaching chemist and researcher in our scientific society.

Here can be seen the intimate interrelation of the finished product of one chemical industry as the raw material of another, in tracing the often tortuous path of the raw material from the earth into the innumerable products that enter finally into the adornment and comfort of life and the indispensable commodities of food, clothing and shelter.

Here is seen the consummation of the effort of him who seeks to extend the realm of knowledge of the behavior of matter; of him who teaches aspiring youth in the essentials of the most fundamental of all arts; of him who makes a new product or a better product cheaper, or finds a new use for an old one; and of him who delves in their commerce, or of the means of their production.

These various classes of men in varying degrees are impelled by the common urge to make money which in this practical world is the measure of their service to mankind. No atavistic thought of community of ownership of the tools of production distracts them from the lode star of ever greater efficiency in this service. No industry is more individualistic and in none is competition for recognition, whether of service or of product, keener. Yet in the midst of all this rivalry, decreed by the Agency that Charles H. Stone says put Rhodamine in coal tar, are men posing as leaders and obsessed with the idea that they can use an instrument of education as a means of monopoly of expression of the intellectual enterprise of this great field.

S. L. REDMOND, secretary of the Chicago section of the American Chemical Society and production manager of the Central Scientific Co., has found the reason for the public's indifference to chemistry and chemists in the latters' failure "to distinguish themselves in the communities in which they live from the large group of manual workers." With peculiar perspicacity he attributes this to the deficiency of professional chemical education in what he calls "vocational direction." Mr. Redmond says it always has been a source of wonderment to him why chemists do not participate in public affairs.

CHEMICAL AGE in July on pages 316-317 explained this phenomenon in the morphology of the chemist, and there set forth the most practicable way to stiffen the backbone of the practitioners of chemistry. We did not confuse professional education with vocational education, the utmost emphasis being placed by educators on the former on thorough grounding in the principles of chemistry and related sciences, with specialization left to industrial association.

Vocational education is education for a trade. That so many chemical graduates are satisfied only with employment as factory analysts is an admission that their academic experience, either because of incapacity or lack of opportunity, has not attained the thoroughness of professional education. Purdue University, Lafayette, Ind., states in a bulletin noted on page 292, July CHEMICAL AGE, that there is a great demand for analytical chemists, of which type there easily can be too many for the material welfare of the craft. On the other hand, we are told frequently that there can not be too many capable chemists.

When we recall the adulation of the chemist by the Society propaganda and professorial speech, as the "savior of mankind," the "cornerstone of industry," and the "hope of the future," we must not be surprised that the young chemical graduate insists on employment as an analyst rather than to admit to a self-sacrificing family and admiring friends that in employment as a shipping clerk, a bond salesman or a floorwalker, he has been an unwilling sacrifice on the altar of natural law.

In the face of all this glorification of the chemist it now comes with little grace for an officer of the American Chemical Society to upbraid the graduate chemist because he won't take a job as a clerk, as a manual laborer or as a salesman on commission. The chemical graduate sees the progress of his boyhood friends who have spent in business or craftsmanship the time he has devoted to preparation for a great scientific profession. We mention Mr. Redmond's wonder why the chemical graduate is disinclined to accept such work, but can not confirm his explanation that it is due to the man's desire to exercise his "play" instinct in the manipulation of laboratory apparatus as an analyst; human nature is too accessible a book to permit such misinterpretation of conduct.

Especially edifying is Mr. Redmond's belief that the unsatisfactory employment situation in chemistry would improve within a generation by including in professional chemical education a short course in "vocational guidance for chemistry students."

HATRED doesn't get anybody anywhere. Just as in individual relations it injures him who hates as much as him against whom it is directed, so in international relations organized animosity has its inevitable kick. The world is big enough for everybody in it and it needs today as never before the conscientious service of every man and the right hand of fellowship of every group and class and nation in working out the problems of that Inscrutable Wisdom that set us here.

We are not unmindful of the biologic significance of hatred and the part it is made to play, near wisely, as an instrument of national self-preservation or aggrandizement. Its futility in aggrandizement is ample precedent for its failure to promote that comity without which civilization cannot flower. Too strongly cannot be condemned the activities of those who would use the passions of war to advance their interests in the pursuits of peace. It is an admission of technical incompetence or of inability otherwise to play the game.

Natural is it to try to make permanent adventitious gains, and what is natural usually is to be commended, particularly as they may relate to national integrity and the preservation of posterity, and with the further limitation that resides always in the mutuality of benefit of constructive intercourse. We would not condone the crimes against humanity wrought by the base obsession of a people with a genius for work, but we would suggest the high propriety of letting history bear its fair responsibility and not seek to confine to the present generation the onus of its horror.

There must be *rapprochement* if the world ever is going to get out of the slough in which war plunged it. Readjustment is not limited to national boundaries; it is a world process. So long as politicians think they can confine it to their own country so long will the beneficence of peace be denied to the world. If you can think of a better anodyne than cooperation to bind up the wounds of war, your ingenuity will not detract one iota from the credit due Dr. Müller for his letter on page 380, or to Dr. Dyes of Berlin for his article in October CHEMICAL AGE in which he seeks to put the best foot forward to regain the respect Americans had for Germans before their great delusion.

DAVID WESSON says that every time you hit a chemical engineer you can hear a chemist "holler," by which our genial friend means that in the ganglionic activity of chemical production the motor reflex of the chemical engineer originates in the sensory stimuli of the chemist. With such sympathetic interdependence recognized, chemists, who appreciate the need of a strictly professional organization of chemically trained men, will find much in Dr. Olsen's account of the growth and service of the American Institute of Chemical Engineers to stimulate their own activity in the establishment of the American Institute of Chemistry.

That the chemical engineer has shown greater enterprise in this direction than the chemist is explained by the fact that the engineering element of the union has brought to it executive capacity, a selling ability, and an eye to the main chance as expressed in the consummation of a successful professional organization based on the principle that the public's measure of a man is determined by what the man thinks of himself.

Chemists as a class can not escape the implications of Dr. Olsen's emphasis on the need of strictly professional organizations, as society is constituted, or read without a certain twitching of a spineless pride how they have been set apart, apparently hopeless in their poverty of the attributes of leadership, in the segregation of the chemical engineer.

Dr. Olsen calls attention to the operation of natural law in chemical segregation, as shown by the formation of numerous small organizations in response to the increasing specialization of chemical knowledge and its applications, obedience to which will become more and more pronounced and hastened, doubtless, by the confusion and distraction incident to the parade, three rings, side show, concert and zoo of the all-embracing scientific society.

Knowledge sooner or later is hooked up with its applications which spread fan-like from its source and upon whose periphery lies little of the identity of interest so pronounced at the source. This source must be kept pure and undefiled and in unrestricted flow, and hence the American Chemical Society should be held true to its original functions in its service as the foremost educational agency in chemistry.

To aid the satisfaction of the passion for growth and to provide the medium of its organized expression for the individuals who increase in numbers as the periphery is approached, is the strictly professional economic organization, concerned not primarily with scientific education but with aiding the individual to sell what he knows, to standardize his capacity and service and to wield the influence in the promotion of the material welfare of the class, that individually he is unable to exert; which enterprise not only is incompatible with its purposes but would be disruptive of our scientific society.

Dr. Olsen's article indicates the need of professional economic organization and shows how this need has been satisfied as regards the most business-like and progressive type of industrial chemist by the establishment and successful operation of an organization that seeks to work in conjunction with natural law in the recognition and reward of capacity, and which by the scrutiny of its personnel makes membership mean something and hence a distinction to be striven for.

Chemical Age in entering upon the fourth year of its existence may be pardoned a brief review of its three years of service. Born almost coincident with a printers' strike that demoralized technical journalism in New York, Chemical Age surmounted this unpropitious hurdle by the virility of its editorial appeal only to meet a period of unprecedented depression to which, for the chemical industries, was added an uncertainty of future stability from which many branches have not as yet emerged. In three years Chemical Age has won an audience the equal of which in a similar period is unmatched in independent chemical journalism in America.

The commendation of steadily increasing readers among the executive element of the chemical and allied industries and the editorial co-operation of leaders of opinion and activity in their respective fields, indicate an appreciation of Chemical Age in the educational activities of chemical industry and a cordial determination to make that place secure. In this, success has been met in a gratifying measure that augurs an auspicious future.

Chemical Age believes that the biggest thing in chemical industry is the men who make their living in it, than whom the personnel of no other industry surpasses in the strictness of its requirements for successful work and in the potentialities of their growth. The industry's growth is determined primarily by the calibre of its chemically trained help. In urging recourse to every approved means to advance the morale of its administrative men and thereby to promote the industry, Chemical Age has been on sound ground and fortified by precedent in its advocacy of the establishment of the professional status of chemically trained men.

Bringing to business men in chemical industry a slant upon their responsibilities and problems obtained from no other source and insuring a readability possessed by no other publication, have earned for Chemical Age the encomium, "It is the only chemical magazine that I read all the way through."

The editorial expression of Chemical Age, in its stimulating common sense, originality and independence, is characterized as unique in chemical literature and as having influenced the quality of expression of some who would seek to mould opinion by the written word. Chemical Age addresses its appeal to the common instinct of all ambitious men to get ahead and enforces the principle that recognition can come only to capacity.

By attacking bunk and bull wherever they raise the banner of hypocrisy; by pulling aside the curtain to expose the motives that move some men; by capacity and courage in the discussion of the common problems of industry and of the foibles of our friends; by commendation of constructive effort whether in the improvement of human relations or in the processes and products of chemical industry; by the presentation of the thought of alert minds in chemical education and in the science, art and business of chemistry, all in a way that every one identified with chemistry can read and understand, have made Chemical Age known, respected and commended wherever chemical enterprise is.

With this outlook upon chemical industry and with the conviction that only that succeeds which serves, Chemical Age in three years has made its place in American technical journalism, for which in grateful appreciation we thank our contributors, our readers and our advertisers.

THE overwhelming approval of American chemists, expressed by a poll of 1,921 for and 77 against the project of an independent economic professional organization of chemically trained men, has the character of a command, has the force of a "round robin" from the ranks, to chemists with the instinct of service and the capacity of unselfish leadership to take the initial steps to effect organization.

Nothing could disclose more clearly than this expression of opinion the perversion by a numerically negligible group of the aspirations of the rank and file of American chemists. A long step has been taken in the attainment of the goal.

I. Random Recollections of An Old Professor

Autobiographical Notes of One Whose Activities as a Teacher and Technologist Span the Old and the New in American Chemistry

By Edward Hart, Ph.D.
Professor of Chemical Engineering, Lafayette College

In writing this account of my own life I have been moved more by a desire to chronicle the doings of great men in the chemical profession than to relate my own small deeds. Only a few of the present day chemists know anything about the doings of that small but devoted band which lighted and kept aflame the lamp of science in America in the earlier days. It has since grown into a great light and chemists have become a great power, but then the light was feeble and the power puny.

Dr. Edward Hart in 1873, age 19. In the following year he came to Lafayette College as assistant to Dr. Thomas M. Drown, who had received the appointment of Professor of Analytical Chemistry

It is natural that we should feel more humble about our deeds as we grow older and recognize more fully their relative insignificance. Few of us can hope to be long remembered and none of us can hope to be remembered forever. There are some requests, however, that no one can well deny, and one of these is the request of an old student and assistant that he be permitted to put on record the work of his older friend and teacher.

In the Beginning

I was born at Doylestown, Pennsylvania, on November 18, 1854, in the house on Main Street now used as the local telephone exchange. My father, George Hart, was a lawyer and his brother, Josiah Hart, a banker. They were in partnership and together built the Grecian building adjoining our home which they used together, one part being my father's office and the other the private bank of J. Hart & Company.

My maternal grandfather, John Watson, was a retired school teacher, about 80 years old when I came upon the stage, of a kindly disposition and a doting grandfather to Patty's oldest son. On the day I was born he hurried off to the local jeweler and ordered a dessert spoon to fit my mouth, had it engraved with my name, and presented it to my mother in recognition of her first effort.

Early Schooling

I need say little of my early life. I was sent to a dame school quite early and taught to say "Sir," much to the horror of grandfather who was a Hicksite Quaker. When I used it on him he said: "Don't thee say 'sir' to me, say 'sir' to the dog!" But what a fine old man he was, and how tender and indulgent to me! Together we went to meeting, and together we sat on the bench facing the meeting with a grandfather on either side of me. Together we visited his friends, one of whom I remember was the wife of Judge Henry Chapman of the local court. Presently I was sent to the Doylestown Academy, where about two years were spent. Then we moved to my father's farm where he had built a new house. It was 50 x 52 feet, one story, so that my mother need not climb steps, and comprised living room, parlor, library, kitchen and four bedrooms. We had a large garden and orchard with plenty of fruit. Here I went to the schoool at Bridge Point, now Edison, and for part of the time, when we had no teacher, to Pebble Hill School.

My father felt, with many others, that our schools were not god enough, so the Doylestown English and Classical Seminary was organized with my father as one of the trustees. Eugene and Benjamin Smith and Henry Hough were the principals and it was under their tuition that my further education assumed definite shape. Under Benjamin Smith I had my first course in chemistry, the text book being Steele's "Fourteen Weeks in Chemistry." About this time my father died and I began the study of the law with my maternal uncle, Richard Watson, who afterwards became county judge. This went on for two years. In the meantime I had been studying chemistry in my mother's garret in a house on Maple Avenue, Doylestown ,Pa., which we had built and moved into after my father's death. Here I had fitted up a laboratory with money earned by surveying land and writing deeds.

I Join Dr. Drown

In the course of these studies I had need of more books and I wrote to Dr. Thomas M. Drown, who had an office at 1223 Girard Street, Philadelphia, and an advertisement in the agricultural papers. Dr. Drown invited me to visit him, which I did. I can

---

Rarely is granted to the teacher of chemistry an opportunity to play so many parts, and to play them well, as has been accorded to Dr. Edward Hart, who approaches the semi-centennial of his association with Lafayette College. When one creates his opportunities, his rendition of the roles that they provide has added significance in our measure of the man.

Dr. Hart has not sat idly on the bank of academic leisure and merely watched the sequence of events; he has participated. In his appraisement of the rise and growth of American chemistry and of its votaries, he richly can say: "All of which I saw and a part of which I was."

Blessed as a youth with eagerness to learn, maturity gave him aptitude to share his favor and versatility in its expression. As a teacher, as a chemist and engineer, as an educational administrator, as an entrepreneur in chemical industry, as an author, editor and publisher in chemistry, he has been and is in the full afternoon of a busy life a leader of his kind.

In these "Random Recollections of an Old Professor," Dr. Hart touches briefly on things he has done and seen and on men he has met in a way not only to stir the affection of all Lafayette men and of his many friends, but to link the past generation of American chemists with the present—Editor, Chemical Age.

remember vividly my sensations as I stepped into his laboratory, the first real analytical laboratory I had seen. Dr. Drown invited me to join him, which after consultation with my uncle Richard, who was my guardian, I agreed to do. I can never forget how kindly and wisely my uncle met the situation which must have been unwelcome, for he loved the law and looked upon me as his successor. In Dr. Drown's laboratory two other young men also were studying chemistry. They were Edward B. Harden, who afterwards was engaged as an assistant to Peter Lesley on the Pennsylvania Geological Survey and then as an engineer on the Panama Canal, and a Mr. Davis, who I think afterwards practised dentistry in Philadelphia.

During my stay with Dr. Drown on Girard Street we had frequent visits from Mr. Joaquim Bishop who had a platinum factory at Sugartown, Chester County, Pa. Mr. Bishop came to town every week with a market basket on his arm containing the platinum crucibles and dishes which he had made during the week for Bullock & Crenshaw at Sixth and Arch Streets, Philadelphia. Dr. Drown was quite an inventor of new platinum apparatus and Bishop came to the laboratory to learn exactly what was wanted. He was an elderly man dressed like a farmer with straw hat and cowhide boots. His manner was quiet and unassuming, but in conversation his wide knowledge and keen observation soon showed itself. He was a very skillful worker in platinum having been an assistant, when he was young, to Hare at the University of Pennsylvania, about the time the oxyhydrogen blowpipe was invented by Hare. I remember that the apparatus was at first soldered with gold. Soon afterwards he informed me that he had found a way to get along without gold.

Early Associations at Lafayette

In 1874 Dr. Drown was called to Lafayette College, Easton, Pa., as Professor of Analytical Chemistry, and I went with him as Assistant in Chemistry. The laboratories were located in Pardee Hall and had been designed for the most part by Dr. Charles McIntire, Adjunct Professor of Chemistry. Dr. Drown at that time had taken high standing, having been made Secretary of the American Institute of Mining Engineers in May, 1873; Dr. R. W. Raymond was president. After he came to Easton Dr. Drown rented a house on College Hill which speedily became a social center. At that time Dr. Raymond was non-resident Professor of Mineralogy and Geology. He came over to Easton on the evening train from New York and spent the night at Drown's house, lectured in the morning and then took the train for New York.

Shortly after Dr. Raymond's arrival friends began to drop in: Frank Firmstone; Frederick Prime, Jr., Professor of Mining and Metallurgy; David B. King, Professor of Latin; John Meigs, tutor of Latin and Greek; Eckley B. Coxe and others. It was a wonderful experience for the raw assistant in chemistry to make such friends and to listen to the brilliant discussions ranging from geology to Percy's Reliques. We sat up late for it was difficult to break away from such attractions.

Of all the men I met there the one who impressed me most by his versatility and the catholicity of his views was Frank Firmstone. At that time he was managing the Glendon Furnaces near Easton which have since been torn down. I do not believe Frank was a great [illegible], for he was too kind hearted and had a comfortable income. [illegible] a great collection of [illegible] at one time [illegible] but finally did no work except on pay day. But there was scarcely a subject broached upon which he was not well informed. He was a good classical scholar, knew the byways as well as the highways of literature, was deeply versed in all branches of science and had been a great traveler. To know Frank well was a whole education. He was kind in manner and in thought and very generous in deed. He was a bachelor and lived with his mother in the old homestead, since enlarged and occupied by the Home for Friendless Children. I was never an intimate but we knew and liked each other and were often in communication about a wide variety of subjects. He had a large library containing many rare books. As I was also something of a collector we often conferred about them, for we both had many books on chemistry and metallurgy. I remember once asking him whether he had a copy of Beck's "Geschichte des Eisens?" "Yes," he said, "I have a copy, and I have read it, too." As this is in five volumes of something like 5,000 pages this remark was exceedingly pointed. I fancy very few who own the work have thoroughly read it.

The fame of Dr. R. W. Raymond was greater than Firmstone's. He was a very witty and brilliant man and also exceedingly versatile, for he wrote many stories and poems, good ones; preached many sermons, also good ones; he was a great engineer and fertile in suggestion. For many years afterwards he was the President of the American Institute of Mining Engineers and led in all phases of its work. It has been asserted that he became somewhat dictatorial in his later years, but when I knew him there was no trace of this. I went to all his lectures that I possibly could manage to attend, and asked innumerable questions which he seemed to enjoy answering.

The interest I felt in King and Meigs was, of course, chiefly social, since I was very faintly interested in Latin at that time. I had read the Fables and Caesar and Cicero and a little of Virgil, but such things were like sawdust in my mouth then. This feeling was increased by the illiberal opposition to scientific subjects which was very strong among the literati of our faculty. Too many of these men, I thought, were preachers and looked at all subjects through the narrow hole of inherited prejudice. Neither then nor since have I been able to admire the narrow-minded. King was very kind and persuasive. The students liked him, and he became a power in college affairs as member of the faculty and since as a trustee. Meigs had a very interesting personality. He was warm-hearted, impetuous, loved fine things and hated coarse ones with intensity. He afterwards became the headmaster of the great school at Pottstown, Pa. I remember little about Eckley B. Coxe, perhaps because he came less often.

Members of the Faculty

In our faculty at that time were: Francis A. March, Professor of English and Comparative Philology; Robert B. Youngman, Professor of Greek; Lyman Coleman, Emeritus Professor of Latin; James W. Moore, Professor of Physics; A. A. Bloomberg, Professor of Modern Languages; T. C. Porter, Professor of Botany and Geology; J. H. Barlow, Professor of Elocution; Joseph G. Fox, Professor of Civil Engineering; and Justus M. Silliman, Professor of Mining Engineering.

We had the dormitory system at Lafayette and I was given a room in East Hall. In the second year I was transferred to Blair Hall where I had two rooms, infested with bedbugs. I was only nineteen when I arrived at Lafayette and exceedingly verdant. The students were good to me notwithstanding. I was promptly dubbed "Buddy," and "Buddy" I have been ever since.

"Dad" March was our great man. His was a wonderful mind. I think he would have been great in any profession. His power of analysis was extraordinary, and he was a keen thinker. I sat in the faculty with him for 30 years and enjoyed watching him. He was apt to keep silent in the early stages of a debate. After he had given the subject sufficient thought he said a few words which usually ended the controversy. His old students swore by him and voted with him. It became a byword that "March and the little Marches always settled things."

Dr. Coleman was quite old when I met him. He had a fine presence and a magnificent voice as well as a great command of language. He was great in the pulpit, eloquent and persuasive. "Bobby" Youngman was sophomore class Dean. At that time the sophomores were decidedly unruly, more so than now. After a "horn spree" or other escapade, it became Youngman's duty to accumulate evidence. This he obtained from the students themselves and his skill in cross examination was wonderful. At faculty meetings he entertained us with recounting "what Mr. X said and what I said"—told without moving a muscle of his face—until we were convulsed.

"Pidy" Moore was inspector of buildings and got to know much about what was going on among the boys. He succeeded often in reforming the heavy drinkers and those who had gone wrong in other ways. He had a very sharp tongue, but on the whole he was a power for good. "Bloomy" was a wit. His dry and pungent sayings are still quoted with enjoyment by the old "grads." I boarded in a private house together with Professor W. B. Owen, then Adjunct Professor of Greek. "Billy" was lame. He was a good speaker, a great favorite with the boys, and his popularity grew as he grew older.

Remuneration

My salary for the first year was \$350. The second year I became tutor with an advance to \$600. In 1878 I was made Adjunct Professor of General Chemistry with a salary of \$800, and on Dr. Drown's resignation in 1881 I was put in charge of the Chemical Department with a salary of \$1,200. In the meantime I had spent two years at Johns Hopkins as Fellow in 1876-78.

During the years up to 1878 bad feeling had gradually grown up between two factions of the faculty. The ill will was directed chiefly against Dr. William C Cattell, President of Lafayette. "Billy," as he was called, was a wonderfully persuasive man. He was a born diplomat. I always felt that he was a well-intentioned man, and that he earnestly desired to avoid strife. But the fight was more or less of a woman's war and without quarter. In the end Cattell won, but shortly afterwards he resigned because of "ill health."

THOMAS M. DROWN, M.D.,
1842-1904.

This likeness of Dr. Drown shows him at the time of his step in 1895 from the Department of Chemistry, Massachusetts Institute of Technology, to the Presidency of Lehigh University.

The Study of Chemistry

Soon after I came to Lafayette I began a systematic study of chemistry. I soon discovered that I knew very little about it, especially about organic chemistry. The worst feature about this ignorance was that in spite of much trying I seemed unable to learn it. I tried several text books in the vain attempt. This was a new experience, for heretofore I had been able to learn anything I seriously attempted; but here I could get no start. It was vain to try to memorize $C_2H_4O_2$ which was the symbol for acetic acid, or $C_{12}H_{22}O_{11}$, the symbol for sugar. This was worse by a thousand times than the multiplication table; but none of the text books gave any clue to relationships between the different compounds.

After trying all the methods I could think of I heard that a famous organic chemist by the name of Remsen was to be at the head of the department of chemistry at the new Johns Hopkins University and that ten fellowships paying \$500 each were open to competition. I immediately wrote to Dr. Gilman applying for a fellowship. Dr. Gilman sent me an encouraging reply and at his invitation I went to Baltimore to see him. He was full of enthusiasm for the new work and told me I should have a fellowship. In the meantime the coal riots of 1876 broke out and the Governor sent out a call for volunteers to which I responded by enlisting. I was the first man to sign the roster at Doylestown, and it was necessary to make me an officer; so I was made fourth corporal. This was an office but not a very prominent one. However, I did no harm, which was all probably that was expected of me. Before our rifles came the riots were over and we were mustered out before our backbones had time to straighten out.

The new chemical laboratory at Baltimore was not ready for business until after the new year. In the meantime I employed my time in writing a "Hand Book of Volumetric Analysis," which was published by John Wiley in 1878. Most of the work on this was done in the vacation of 1877.

The Fellowship at Johns Hopkins

I thoroughly enjoyed my stay at Johns Hopkins. There were twenty Fellows. We were all as poor as church mice, full of ambition and enthusiastic in our several lines of work. A finer set of young men barring two or three mistakes never was got together. Here I again began to try to open the oyster, organic chemistry, and I finally succeeded, not, however, without many falls. The clue came with a copy of Richter's "Organische Chemie," which I had bought. He showed, in a moment of forgetfulness, that malic and tartaric acids were related, one being oxy- and the other dioxy-succinic acid. This was clue enough for an earnest searcher, and I soon mastered the elements. I afterwards discovered that some of my colleagues still were as profoundly ignorant of organic chemistry as I had been.

At the Johns Hopkins were: Morse, Assistant in Chemistry; Hall, who afterwards went to Haverford;

and Iles from Columbia. Morse and Hall were Amherst men and had studied in Germany, I think at Gottingen. Afterwards we were joined by Laurie from California and Fahlberg from Leipsic. Among the other Fellows I got to know well was Jacques, who was studying physics. My training in physics had been deficient and I secured permission to take a course under Dr. Hastings. Hastings was a good teacher, but I did not profit as much as I wished because I had had no laboratory physics; so I was put in Hastings' laboratory. The apparatus was very crude and not to my taste, lacking in precision.

I told Dr. Hastings that I had been accustomed to accurate apparatus and asked whether I might not use a precision pendulum in the case in order to measure accurately the force of gravity. He said he was not allowed to do that but he thought I should work with Dr. Rowland, and had me transferred to Rowland's laboratory. Imagine my delight! I worked with Rowland nearly three months. They were red-letter days. He was a wonderful man, and as peculiar as he was wonderful. While I was with him he was working on the mechanical equivalent of heat and the atmosphere of the neighborhood was rank with the exhaust of a kerosene engine which furnished the motive power.

Jacques told me many stories about Rowland's peculiarities and still more about Sylvester, who was Professor of Mathematics. Sylvester was from Cambridge. Another great man was Josiah Royce, then a Fellow, one of the ugliest men I ever knew. Remsen was a great lecturer and was much liked. He was fair and inclined to be kind. I learned many things beside chemistry of Remsen. I afterwards printed the American Chemical Journal for him and found him a very good man to work for. Many employers try to put all their own blunders on the printer. He did not, and occasionally he took notice when we did well, and praised our work. This is almost unprecedented in an editor.

At the Johns Hopkins I also met Dr. Mallet, who came from time to time to lecture on industrial chemistry. I offered to assist Dr. Mallet in setting up the experimental apparatus and my offer was accepted. He was rather formal in manner, but very pleasant. I learned a great many things of him. He was fond of telling about his experiences during the great rebellion when he was in charge of the chemical manufacturing for the Confederates, and I remember he told us that they separated silver from their lead by the Pattinson process. They had accumulated in this way several tons of lead very rich in silver when a sudden and imperative order came for more bullets. They were obliged to cast the rich silver-lead alloy into bullets and send them off to be shot at the Yankees. I afterwards became well acquainted with Dunnington, his assistant at the University of Virginia, and after Dr. Mallet's death I visited the University and had Dunnington take me through the Doctor's laboratory and the collection of specimens used to illustrate his lectures. During the trip Dunnington had very little to say about his own work. Dr. Mallet and his work filled his whole thought, and all that he said illustrated his perfect love and reverence for his science. Shortly afterward the laboratory was burned and the collection destroyed.

During my stay at the Johns Hopkins I was engaged, for the most part, in filling deficiencies in my earlier education. I studied German among other things; in fact, I did not study German, I blasted it out. I bought a copy of Mohr's "Titrirmethode" and translated it as well as I could without a teacher and without help. After I had written out many pages of the translation I turned back to the first page, read my translation and compared it with the original; then I laughed heartily, for I had learned so much more in the interval that the meaning had become clearer and I saw the mistakes I had made.

Establishment of a Chemical Industry

It was about the time of the factional strife in the Lafayette Faculty, which resulted in the Pyrrhic victory of Dr. Cattéll, that I began to see the handwriting on the wall. The college was poor and my expenses were increasing as my family of children grew. It was evident that I must remain a poor man unless some other plan was followed, so I began to look around for something additional.

In 1881 one of my graduates, John T. Baker, and I determined to go into the business of making refined chemicals. We were entirely without experience and with little capital, but we had plenty of courage. I had saved $500 from my salary by close economy and this was our capital. We rented a lot containing about an acre of rough land full of springs, which supplied the necessary water, for $10 a year, and put up two rough buildings of hemlock boards. In these we built our furnaces and began the manufacture of chemically pure hydrochloric, nitric and sulphuric acids and ammonia. Our first products were not nearly so pure as later ones, but prices were high and after two years our operations began to show a profit. But now we had exhausted our capital and found our producing capacity too little. In this dilemma we decided to take another partner in the person of George P. Adamson. Business soon became brisk while prices fell. It became evident that we must locate next the railroad to decrease costs. I had no vacation that year. We bought five acres of land two miles from Easton and I spent my vacation grading the land and putting up the buildings. I was boss, timekeeper and errand boy.

When the buildings were finished we started operations with a new outfit so as to maintain production steadily. It was about this time that my inventive faculty began to work. We had bought our crude nitric acid up to this time and had it shipped to Easton on flat cars. This was dangerous to the men who handled it and expensive, so we concluded to make our own acid. I had an iron pot cast about three feet in diameter in two pieces. The upper half had a six-inch opening covered with a flat plate and was fastened to the lower hemisphere with bolts and a rust joint. I built a furnace around this, had holes bored in the plate for six good sized Liebig's condensers which were stemmed in with asbestos fiber; nitrate of soda and oil of vitriol were put in the pot, the fire was lighted and the fun began. Notwithstanding the imperfections of this apparatus I made several tons of nitric acid in it while I was building an improved retort and condenser of my own design. This did not work well until I discovered that my operators were systematically "queering it," after which I hired new men and got it to going,

The retort was a cylinder, self dumping. It worked well but was never widely adopted because it was too expensive and liable to leak, but the condenser was a dandy and was soon in general use, greatly to the benefit of our finances. Shortly before this I had invented and patented the ceresine bottle for hydrofluoric acid which also brought in a steady revenue.

All my days and nights were now given to schemes for making new chemicals or devising cheaper methods. My partners and I worked out methods for washing filter paper, making purer and cheaper ammonia and finally an apparatus for distilling nitric and hydrochloric acids. This tubular boiler made of glass tubes was a very daring but successful idea of my own. My partners took no interest in it at first, but it was a wonderful improvement, dividing our coal bill by 6 and greatly increasing capacity and decreasing handling. With Adamson's help I perfected an apparatus that would redistill, bleach and dilute nitric acid in one operation.

We spent much money in experiments; our lot was full of board shacks containing them and we made steady and rapid progress. We were young, full of enthusiasm, and able to work fifteen hours of the twenty-four.

The Return to Lafayette from Johns Hopkins

I had held the fellowship in chemistry at Johns Hopkins for two years, 1876-1878, and Dr. Remsen said I might have it for a third, but I declined, thinking it time to go to work once more. In the fall of 1878 I returned to Lafayette as Adjunct Professor of General Chemistry with the understanding that I was to deliver the lectures, for Dr. Drown disliked lecturing.

I immediately began work on a text-book of organic chemistry for beginners. This was much better for such men than anything I had seen, but it was several years before I discovered the best way to teach organic chemistry. I can take a class of beginners now and fill them full of enthusiasm in three weeks. My experience in teaching chemistry has been an extended one; so long a one that I feel I have a right to an opinion. For most of the text-books on the subject that have been written I have nothing but contempt. How intelligent men can put such treatises into the hands of beginners, *beginners,* understand me, passes my comprehension. Most of them shoot far over the head of the average student, leaving behind stupefaction and discouragement.

Some of the most eminent chemists have written the stupidest books for beginners. The worst feature of the whole business is that their authors do not see their blunder when you point it out. They persist in thinking that what is clearly perceptible to them after years of intensive training also must be perceptible to men who have had no training; they are quite unable to place themselves in the other fellow's shoes. And yet the proper method is so perfectly simple. Dr. Porter W. Shimer once said to me that when most people put up a building they first build a scaffold, and when they finish the building they no longer need the scaffold or admire it; they pull it down and burn it.

Dr. Thomas M. Drown

I have said very little about Dr. Drown, but I should like to write volumes. He was a wonderful instructor, full of enthusiasm and able to awaken and stir the minds of the boys to wonder and admiration. His kindness of heart pervaded his whole being. His manners were charming and his personality most engaging. He walked through the laboratory with his head cocked to one side slightly, stopping at each desk with a pleasant word, inquired into what was being done and offered suggestions for improvement in the most pleasant way possible.

I often thought I should be willing to give almost anything for Drown's way with the boys. He was greatly loved, and he deserved and returned it. He was the soul of honor and truth. In so many ways I have profited by his goodness that I fear to write further lest I be thought fulsome. When Pardee Hall was burned in 1879, Dr. Drown enlisted a body of students in getting the Transactions of the American Institute of Mining Engineers out of the building. Some five thousand volumes were stored there and all were saved. He lost his own library, however, for there was not time to save both. This came to the knowledge of the members and a subscription was quietly started to enable him to replace them.

At the Montreal meeting of the Institute in that year Dr. Raymond, as spokesman for the Committee, in a very witty and entertaining address, presented to Drown in the name of his fellow members a check for over $3,000. Taken quite by surprise Dr. Drown responded in a speech that greatly moved his auditors; for it was appropriate, eloquent and sincere, without a single false note. These speeches, with an excellent portrait of Dr. Drown, were reproduced in a testimonial volume distributed to the subscribers to the fund. Dr. Drown was secretary, from 1873 to 1883, when he felt compelled to resign. During that period he had edited eleven volumes of Transactions. His resignation was brought about in large measure by the ill health of his older brother.

Dr. Drown's father had been an umbrella maker and, on his father's death, his brother inherited the business of Wm. A. Drown & Co. By reason of his brother's ill health the business became embarrassed and Dr. Drown was called to the helm. He talked very little about his work in this matter, but it is known that at considerable personal sacrifice he rescued it from bankruptcy and paid the creditors in full. This he was neither legally nor morally obliged to do.

On his resignation as secretary of the American Institution of Mining Engineers, he was elected an honorary member and, in 1897, he was elected president. In 1885 he was made professor of chemistry in the Massachusetts Institute of Technology, and in 1887 he became chemist of the Massachusetts Board of Health. In 1895 he was elected president of Lehigh University, still retaining his advisory connection with the State Board of Health, and in addition, in 1898, he became an adviser of the Massachusetts Department of Food and Drug Inspection. He died at Bethlehem, Pa., in 1904. In a sketch of his life work written by Dr. Raymond for the Transactions, he says: "In the combination of gentleness with power, candor with conviction, wide culture with special and accurate knowledge, generosity with judgment, genius with industry, sensitiveness with patience, the keen intellect with the pure heart, the power to win love with the power to command esteem, the wisdom of the world with the wisdom of the world to come, our dear friend stood conspicuous among men."

H. J. Baker & Bro., 81 Fulton Street, New York, who recently relinquished the agency for the Alsatian Potash Society, have been appointed selling agents for the German Potash Syndicate in the United States, exclusive of the Pacific Coast. The Alsatian Potash Society, 25 West 43d Street, New York, is now represented in the United States by W. E. Howe, formerly connected with the Nitrate Agencies, Inc.

McAfee Process for the Cracking of Petroleum

By the Use of Aluminum Chloride as Catalyst

THE issue to Dr. Almer M. McAfee, chief research chemist, Gulf Refining Co., at Port Arthur, Texas, of Patent No. 1,426,081 on August 1, after protracted litigation in the Patent Office and before the Court of Appeals of the District of Columbia, dating from the filing of his application Sept. 30, 1913, concludes the adjudgment of Dr. McAfee as the inventor of a notable process for converting high-boiling petroleum distillates into low-boiling products of remarkable quality at much reduced temperatures through the use of anhydrous alluminum chloride as a catalyst. In a later patent granted Jan. 31, 1922, Dr. McAfee describes improvements in his original process whereby the operation is made simpler and more efficient.

Gasoline is the commercial name for low-boiling petroleum products suitable for use in internal combustion engines. Most gasoline was formerly made by simple distillation of crude petroleum; but much is now made by a cracking distillation, a distillation which breaks up the heavier oils of petroleum to give lighter oils such as merchantable gasoline. Gasoline made by cracking is not of as good a quality as that made by a simple distillation of crude oil, the so-called refinery gasoline. It is unsaturated in its nature and the odor is not liked. A much better grade of artificial gasoline can be made by the action of dry aluminum chloride on various heavier petroleum oils, kerosene, solar oil, gas oil, lubricating oil, crude oil, etc.

When a heavy oil, such as, for instance, gas oil, is mixed with a few per cent of dry aluminum chloride and the mixture heated, it comes to a boil somewhat below the normal boiling temperature of the particular oil used. With a gas oil which begins to boil at 600° F., in admixture with 5 per cent or so of aluminum chloride ebullition sufficient for distillation will occur somewhere between 500 and 550° F. The vapors produced in ebullition of the mixture contain gasoline and also aluminum chloride (or vapors of compounds of aluminum chloride with constituents of the oil). As Dr. McAfee discovered and claimed in Patent No. 1,424,574 granted Aug. 1, if the operation be so conducted that the mixture in the still is kept in vigorous ebullition and the vapors are cooled to 300-350° F., the aluminum chloride or its compounds can be condensed and returned to the still while the gasoline vapors go forward and can be condensed in any suitable condenser.

It is absolutely necessary to condense the aluminum chloride vapors by some sort of cooling arrangement between the stills and the condenser, both to keep the aluminum chloride from escaping from the zone of reaction and also to prevent aluminum chloride reaching cold parts of the condenser and plugging it. If the vapors at the point of exit from these cooling means to the condensing means be held at a temperature of around 300° F., the product recovered from the condenser will be commercial gasoline and of a high grade being saturated in its nature, of pleasant odor and not inferior in any way to natural or refinery gasoline. If the temperature be kept somewhat lower, say, 275° F., the product recovered will be an exceptionally high grade of gasoline suitable for aviation and similar purposes. By holding the temperature at the point of exit at about 350° F., the condensate will contain more or less kerosene or burning oil which can be separted from the gasoline also formed by redistillation in the usual manner.

While this operation, as just stated, is simple in its nature and can be operated with simple apparatus, in practice in order to get the best results a methodical operation with due regard for the peculiarities of the material is desirable.

Aluminum Chloride

Aluminum chloride is a rather hygroscopic solid, which is instantly decomposed by contact with moisture to give a hydrated aluminum chloride which has no catalytic activity whatsoever and on the other hand is quite undesirable in the stills. At the usual still temperatures, hydrated aluminum chloride tends to give off HCl gas which may pass over into the gasoline, necessitating an after-treatment with alkali for its removal. In the operation it is therefore necessary that everything be kept as dry as possible; the oil being heated to drive off moisture prior to using it and the chloride being shielded from the action of atmospheric moisture in transportation and handling as much as may be between the point of production and the point of use.

As the aluminum chloride comes from the condensing chambers in the usual methods of production, it is in the form of hard crystals or crystalline lumps, which are frequently rather large. As the action of aluminum chloride on hot oil is rather energetic, the addition of solid lump aluminum chloride to a boiling mass of oil in a still is inconvenient and may result in foaming or irregularity in distillation. Comminution of lump chloride in order to enable the use of ordinary types of feeding apparatus is undesirable; partly because the hygroscopic nature of the material renders grinding difficult and partly because it is hard to prevent access of atmospheric moisture.

Dr. McAfee pumps the aluminum chloride into the still in the form of a fluid magma made by stirring up the solid material with warm oil, and thereby is enabled to supply it at any rate and in any amount without fear of foaming or disturbing the regular process of distillation. While aluminum chloride is not very soluble in cold oils, it blends readily on simple stirring or agitation with oil at a temperature of about 150° F., making a thin fluid magma which can be readily pumped and handled. About one part of oil is required for one or two parts of aluminum chloride to make a mixture which, at about 150° F., has the consistency of a thin coal tar.

If there be any moisture in the material, HCl is developed in this mixing operation and may be allowed to escape; and it does not develop in the still. The best temperature in this mixing operation is around 150° F. At higher temperatures the aluminum chloride may act on the oil with development of flammable vapors (gasoline) while at lower temperatures the mixture tends to thicken and the aluminum chloride to separate. The process is operated at atmospheric pressure.

Procedure

In the ordinary operation of running a still continuously with replenishment of the supply of aluminum chloride from time to time in the form of a fluid magma pumped in, the fires are slackened a little just prior to the introduction of the aluminum chloride; lessening the heat sufficiently to allow the temperature of the vapors above the oil to drop somewhat while not lowering the temperature of the oil itself perceptibly. As aluminum chloride enters there begins an evolution of gasoline vapors but by proper control of the firing and of the introduction of aluminum chloride magma, the progress of the distillation can be made absolutely uniform, the stream of condensate from the gasoline condensers being uninterrupted and not varying in volume.

In the still the aluminum chloride so introduced blends readily with the oil and it exerts its action thereon. In this type of distillation it is customary to provide the still with some form of agitating means; usually a chain drag or the like. This serves to keep the aluminum chloride in suspension against its tendency to settle. In its action upon oil, the chloride gradually loses activity or catalytic power and becomes converted into a mass having a more or less pitchy nature when heated. Dr. McAfee found that this thick material is not as readily stirred up into oil as is fresh or active aluminum chloride and has a greater tendency to settle; and the difference is sufficiently great to warrant a convenient removal of exhausted chloride from time to time.

It is merely necessary, while keeping the chain drags running at the usual rate, to draw off the thick layer on the bottom in order to remove all the exhausted chloride. In so drawing off the thick material, which may be done by an ordinary type of tar gate, very little oil accompanies it; and most of this oil may be recovered by settling as the residue becomes cold. It is not necessary to interrupt firing or the stirring in order to remove the exhausted material. The exhausted material so removed has practically no activity left in it and it may be advantageously sent to the chloride recovery plants.

By feeding in aluminum chloride as a magma in the manner described and removing exhausted chloride from time to time, the stills can be kept running continuously without at any time slackening or diminishing the flow of distillate. The oil to be converted is pumped into the still continuously. In so doing the operation becomes very efficient and the yield of gasoline from the oil is very high while the activity of the aluminum chloride is utilized to the fullest extent. There are no "bottoms" or residues of oil; all the oil going into the still, except for a slight loss, being converted into gasoline. In practice, however, the stills ordinarily are shut down after a run of about two or three weeks for the purpose of inspecting and repairing the stirring mechanism.

The stills, so far as the process is concerned, may be run indefinitely longer, but it is good practice to shut down every two weeks or so for inspection. In so closing down, however, the contents of the still are simply transferred to another still and distillation continued. By so doing, distillation of the oil body is practically continuous, there being merely the pause necessary to transfer the oil from one still to another. As a matter of convenience, it ordinarily is arranged to shut down and transfer at a time just prior to the addition of fresh aluminum chloride. If a series of stills be used and started somewhat out of phase, this will always give the operator an empty inspected still into which to transfer the hot oil from a still to be shut down for inspection.

Benzol Poisoning: Its Occurrence and Prevention

Charles F. Horan

Manager, Department of Hygiene and Safety, Hood Rubber Company

BENZOL is one of the products of the fractional distillation of coal tar the crude coal tar being derived from either the coking of coal in by-product ovens or from the manufacture of illuminating gas.* Among other products, such as phenol, benzol is recovered from the light oils which distill at temperatures up to 170° C. These light oils, after being purified by sulphuric acid, are redistilled and deprived of their basic constituents by extraction and the phenols are removed by washing with dilute caustic soda. The oils are then separated by fractional distillation into crude benzol, which comes over from 70 to 130° C., and solvent naphtha, which distills over from 130 to 170° C.[1]

Composition and Nomenclature

The crude benzol thus obtained, and which is composed mostly of benzol and toluol, is again distilled and the following commercial products of benzol obtained: Pure benzol, a colorless volatile liquid, which boils at 80.5° C.; ninety per cent benzol,† so called because 90 per cent of the product should distill at a temperature of 100° C.; fifty per cent benzol, which contains 50 per cent of bodies distilling at 100° C. This material contains only from 40 to 50 per cent benzol, the remainder being a very complex mixture of unknown hydrocarbons. The solvent naphtha derived from the first process is used extensively in Europe as a solvent for rubber. It contains no benzol but consists of xylol and other hydrocarbons.

The fact that benzol is also known as "benzene" has caused it to be sometimes confused with petroleum benzine or naphtha gasoline. It would be well for us to remember that: Benzol is "benz*e*ne." Naphtha is "benz*i*ne." Solvent naphtha is "coal tar benz*i*ne."

Benzol differs from naphtha in that it is a definite chemical substance, C_6H_6, while naphtha is a complex mixture of bodies of unknown chemical structure. Naphtha is merely a name covering a group of hydrocarbons which distill from petroleum, while benzol is a standard material of definite chemical structure. It is because of its being a uniform substance that has led to its increased use in industry.

---

*A paper presented at the 11th Annual Safety Congress of the National Safety Council, Aug. 28-Sept. 1, 1922, Detroit, Mich.

†According to Rambousek this product is composed of from 80 to 85 per cent benzol, 13 to 15 per cent toluol and 2 to 3 per cent xylol. It contains as impurities traces of paraffines, olefines and sulphuretted hydrogen.

Commercial Uses

Knowing something, therefore, of the chemistry of benzol and how it differs from other commonly used solvents, the commercial uses of the material are of importance. By far the greatest part of commercial benzol has been used as the initial raw material of coal tar dyes. It also serves as raw material in the manufacture of explosives, artificial perfumes, sweetening substances, pharmaceuticals and photographic chemicals—in fact, it is an indispensable raw material of our organic chemical industry. Its solvent properties lead to its use in the rubber and artificial leather industry and in the manufacture of quick-drying paints; its ability to dissolve fatty substances leads to its employment in the dry-cleansing industry and as an extraction agent for fats in bones and seeds. Benzol also finds extensive use in the manufacturing of lac varnishes and in the extraction and purifying of asphalts, resins and alkaloids. It is an excellent solvent for removing the naphthalene contained in coal gas, which so frequently obstructs service pipes.

According to Kohler, more benzol is at present being used as fuel for motor cars than is consumed in organic chemical manufacture. Much of the gasoline sold under trade names contains up to 35 per cent of benzol. Another important use for benzol is in paint removers. Some of these preparations consist of benzol, paraffin and wood alcohol; benzol, alcohol and turpentine; or benzol, paraffin and acetone. Benzol is a much more powerful solvent than naphtha and is now near naphtha in price, so there is a double temptation to use it in place of other solvents. From the standpoint of safety it is to be preferred to petroleum naphtha or gasoline because of its low electric excitability; on the other hand, it is more poisonous by far than naphtha.

In addition to benzol, we find its derivatives are used extensively in industry. Nitro-benzol (oil of mirbane) is used as a starting point in the manufacture of anilin and is also consumed industrially as a perfume in the manufacture of cheap soaps. While nitro-benzol is not an explosive it is used in the manufacture of explosives to reduce the freezing point of nitroglycerin. Other nitro derivatives of benzol are used extensively in the industries of this country. It is evident from the foregoing that not only is benzol widely used in the industries at the present time, but because of the low price of this material and its high solvent qualities we shall presently find petroleum distillates supplanted by benzol in many additional industrial operations.

Industrial Poisoning

Poisoning by industrial processes arises, from the most part, by the inhalation of the fumes. Because of its fat-dissolving qualities, benzol may also be absorbed through the unbroken skin, but it is doubtful if this mode of entry presents a serious hazard in industry. Lehmann has shown that a man breathing a mixture of benzol and air actually absorbs 80 per cent of the benzol inhaled.

There seems to be some difference in the toxicity of pure and commercial benzol. The older reports indicated that commercial benzol was more dangerous than the pure, but the experience in the rubber industry would indicate that this conclusion was unfounded, there seeming to be a direct connection between the boiling points of the benzols and their ability to do harm; the compounds of lower boiling points appearing to be more dangerous than those of higher boiling points. This is probably due to the fact that the amount of vapor given off by the low-boiling point benzols is greater and thus a larger dose is breathed by employees exposed to the material. Considerable variations in individual susceptibility to benzol-poisoning exist, this being considered as the reason why the material has been used in some industries over a long period of time without serious symptoms having arisen.

Differences of Opinion as to Dangers

Concerning benzol there is some division of opinion within the ranks of industrial hygienists as to its real dangers. There are those who consider the material with alarm and look upon all employees exposed to the vapors of benzol as being potential fatalities; there are others in industry who consider the vast amount of the material used and the relatively few cases of poisoning as evidences of lack of danger from benzol. These non-alarmists tell us that very few employees in industry are susceptible to benzol poisoning, and even in cases where little organized health protection is offered to employees using this material, cases of poisoning are rare and not usual happenings. They suggest to us that the statement "things are not what they seem" contains an element of truth; they remind us that industrial-accident statistics show the wheelbarrow to be more dangerous than the steam locomotive and the cement brush to be a greater fire hazard than the blowtorch.

In the central ground, and accepting the middle course, are those experienced industrial physicians and sanitarians who realize that the material is not nearly as dangerous nor as safe as some persons believe; that it can be used with relative safety only at the expense of the maintenance of certain precautionary measures.

Prior to 1914 several cases of benzol poisoning had been reported by Snelling. Three girls, aged 14 to 16 years, were employed in a Maryland can factory in which the containers were sealed with a mixture of benzol, resin and rubber. Three other cases have since been reported from this factory. The most famous recorded cases of chronic poisoning were from a rubber tire factory in Sweden where nine young women, from 15 to 20 years of age, were taken ill with hemorrhages from the mouth, stomach, uterus and nose. Four of these girls died after an exposure to benzol lasting from three weeks to three months. In 1916 Dr. Alice Hamilton reported fourteen new cases of sudden acute poisoning with seven deaths.

The reports of German factory inspectors for 1912 deal with three cases of poisoning, two of them being fatal. One man was employed in painting the interior of a barrel with benzol paint, another climbed into a washing machine in a dry cleansing establishment and the third was employed in a distilling plant and forgot to turn on the cold water for the condensation. In 1918 British factory inspectors reported the case of a man overcome by benzol vapor while employed in a distillation plant. He was revived with oxygen and returned to work on the second day, only to be again overcome and die.

Recorded Cases of Poisoning

A number of cases of benzol poisoning have been recorded where employees were overcome while cleaning tanks in which benzol has been stored. In one case a benzol kettle had been empty for twenty-four hours, was washed out twice with steam and allowed to stand, filled with cold water, over night. As the workman went into the kettle a strong stream of air was blown in through a pipe. In spite of these precautions the workman was overcome, but was rescued. One of his fellow workmen who assisted with the rescue was overcome and died within ten minutes.

One British case is recorded where a tank car was unloaded, washed with water, steamed out and then left, filled with water, for twenty hours; then washed twice with water, boiled for twelve hours and finally left for 10 days with a 16-inch manhole opened. A man who was then sent into the tank collapsed and although he was revived in time, one of his rescuers died.

There have come to my personal attention, during the past six years, three fatal cases of poisoning to tirebuilders in a pneumatic tire plant; one fatal and one acute case to female operatives in a thread-treatment room in a cord tire plant; one fatal case to a laborer engaged in digging a trench along a leaking tank of benzol; a fatal case to a foreman in a rubber reclaiming department; three fatal cases in the coating-room of an artificial leather factory; and some dozen cases of less serious acute poisonings in a golfball department of a small rubber industry.

Temperature and Humidity

So far as age is concerned, the very young, the old and the female seem to have particular susceptibility to the vapors of benzol. Debilitated conditions, organic diseases especially of the heart and kidneys, addiction to alcohol and excesses of all kinds materially increase susceptibility. Vigorous muscular individuals with rapid circulation and deep breathing are overcome more readily by benzol fumes because of the rapidity with which the vapors are absorbed.

As we would naturally expect, conditions of temperature and humidity effect susceptibility to benzol poisoning. Thus on hot, humid days, or in interiors where the air is hot and stagnant, poisonings are more liable to occur because of the greater volatility of the benzol under these conditions, and also, perhaps, because of retarded elimination increased pulse rate, and hence the greater flow of blood through the lungs under these circumstances.

The symptoms of poisoning naturally vary according to the length of exposure, individual susceptibility and the amount of benzol absorbed.

Preventive Measures

From the standpoint of those engaged in safety work, the methods of prevention of benzol poisoning are of much more importance than any other phase of this problem. The first step in the prevention of the poisoning is to be found in the physical examination of each applicant for work and periodic re-examinations of those exposed to the hazards of benzol. Persons suffering from organic diseases, especially of the heart and kidneys, which diseases tend to retard elimination, should not be placed in occupations where the exposure to benzol constitutes an occupational liability. Physical examinations should include a differential blood examination, an estimation of haemoglobin and a determination of the coagulating time of the blood. Experience indicates that re-examination every four weeks is not too often.

All cases of absence from work should be investigated if the absence extends beyond twenty-four hours. In event of the employee being away from his occupation because of sickness, he should be visited by a physician familiar with the early symptoms of benzol poisoning. Note should be kept of the state of health of the workers, the results of periodic physical examinations, the duration of symptoms and the treatment of illnesses that occur. Care should be taken to have the records complete and entries such as "coagulating time, normal," should be discouraged. Employees should be encouraged to use the factory dispensary in event of illness and it hardly requires to be said that medical aid should be within easy reach.

Education of the Worker

We have now come to the subject of the education of the worker. In the prevention of occupational diseases the co-operation of the employee is indispensable and is the most important condition of an effective defence. The best regulations and preventive measures are worthless if the worker does not observe them. The employee should be advised as to the dangers incidental to his employment and he should be acquainted with the symptoms which demand early medical attention; he should be taught the aims of the management with reference to the prevention of industrial poisoning.

Fumes Must Be Driven Off at Bottom

Dr. Hamilton reports a procedure at the Gary plant of the United States Steel Corporation in connection with safety in cleaning apparatus which has been used in the manufacture or storage of benzol. After washing out the empty tank and steaming it a cage of white mice is lowered into the tank. If the mice are overcome by the gas the flooding and steaming are repeated until the mice show no effects of the benzol. The use of a portable electric-driven gasblower to exhaust air through the drain pipes of tanks has been of much value. Because of the benzol vapor being heavier than air, it is necessary to exhaust at the bottom of the tanks and drain pipes are conveniently located for this purpose.

Where benzol is used industrially as a solvent it has been found necessary to install general room ventilation, rather than hope to confine the ventilation to a small number of exhaust hoods. In a scheme of general room ventilation it is well again to remember that benzol vapor is heavier than air and should be exhausted at the floor level. Our experience illustrates that an air change of thirty times an hour is desirable and that the flow of air toward the floor should be not less than six feet per minute. The British standards in rooms where aeroplane wings are "doped" concurs with our ventilation of thirty changes an hour.

In conclusion permit me to say that with an efficient method of physical examinations, with regular re-examinations; the changing of an employee's occupation as quickly as he shows either an abnormal reduction in the number of blood cells or an unusual increase in coagulating time; together with adequate ventilation, benzol not only can, but is, being used without danger.

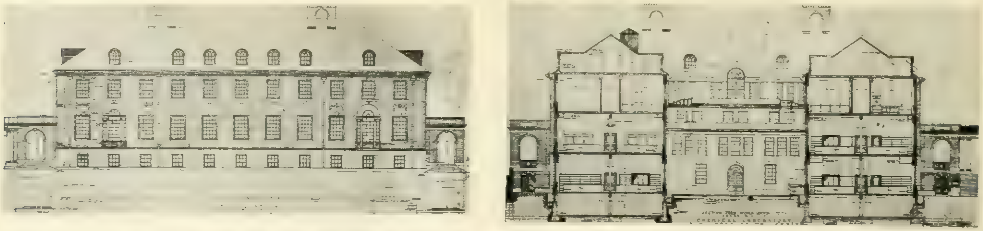


Fig. 1. Exterior view and cross-section of the new chemical laboratory at The Johns Hopkins University.

Chemical Education at Johns Hopkins

The Erection of the New Chemical Laboratory Directs Attention to the Influence of Dr. Ira Remsen on Chemical Education and Chemical Industry in America—The Laboratory Will Mark a New Era in the History of Chemistry at This Institution

THE erection of the new chemical laboratory of the Johns Hopkins University will mark a distinct epoch in the history of chemistry at Johns Hopkins. It will be of interest to recall briefly the work that has been done in the old laboratory which soon is to be abandoned. For forty-six years it has been not only one of the foremost centers of instruction in graduate chemistry in this country but enjoys the distinction that here began systematic instruction in graduate chemistry and methods of research in this country.

DR. IRA REMSEN

Professor of Chemistry; Director of Laboratory, 1876-1908; President, The Johns Hopkins University, 1901—

Dr. Ira Remsen

The Johns Hopkins University was opened in 1876, and early in that year Dr. Ira Remsen, who was then professor of physics and chemistry at Williams College, was appointed professor of chemistry. President Gilman had announced that in the new university provision would be made for those who wished to carry on research. Remsen had spent five years in Germany at Munich with Volhard, at Göttingen with Wöhler and Fittig and two years at Tübingen, where he served as assistant under Fittig. He had imbibed the spirit of research and, as he stated in an address published a few years ago, his highest ambition was to secure a place where he could live the life of an investigator. The appointment to the professorship at Johns Hopkins gave the opportunity. President Gilman was in full sympathy and gave every encouragement. His injunction to those who joined him was "Do your best work in your own way."

The University at that time was rich and the administration was generous. Everything in the way of apparatus and books that seemed likely to be useful was provided. A simple, small laboratory was built. A few students, less than half a dozen, were admitted to the laboratory and work was begun. At that time there was no place in this country where special provision was made for advanced students, that is to say, for those who had completed the college course and wanted to go further. Those who were charged with the duty of getting the new university under way were of one mind in regard to one thing, viz.: They were convinced that an essential feature of advanced work is research. That was the keynote of the new policy. It was this fact that at the beginning distinguished the Johns Hopkins University from all other institutions in the country. At that time a college graduate who wished to go further went to Germany for advanced work, but now it was possible to do something of the same kind at home.

In a short time a small group of well prepared young chemists gathered together in the new laboratory and the experiment was begun. One readily can believe that under such an inspiring teacher as Dr. Remsen genuine enthusiasm pervaded the atmosphere of the laboratory and that much of the system abroad had taken root.

Dr. Remsen's interests were largely at that time in the field of organic chemistry and it is not surprising that the subjects then investigated were mostly in that field. The really important thing was that methods of research were being inculcated without regard to the kind of work that was done. The main thing after all was the teaching of research, for it is generally true that having once become acquainted with the methods of research the desire to contribute something of one's own at once asserts itself; opportunity and mental ability thereafter determine the result. In general the main accomplishment during the early history of the laboratory was the creation of an atmosphere for the development of research, which has persisted with undiminished intensity.

Saccharine

One of the interesting developments in the laboratory during these years was the discovery of saccharine. This substance made its appearance in the course of an extensive investigation of the oxidation products of certain organic substances. These investigations were undertaken under Dr. Remsen's direction. It was never thought that one of the products obtained in this work would be the sweetest thing on earth. Scientifically, saccharine was simply one of the substances brought to light and recorded in the course of this work. Practically, however, it has been of much greater interest than any of the other substances and came to play an important part in the World War. According to a recent publication 1,000 tons were made that took the place of 300,000 tons of sugar.

American Chemical Journal

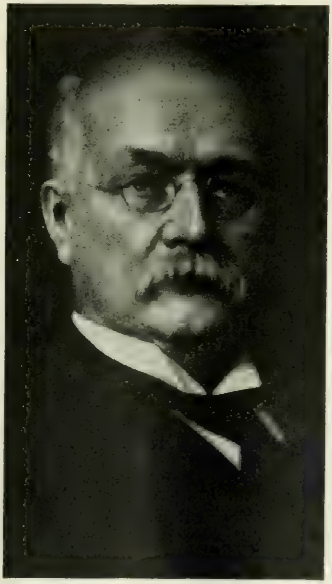
For many years Dr. Remsen remained active head of the laboratory. Many investigations were carried out under his direction and many chemists were trained by him, some of whom occupy leading positions today.

In 1879 Dr. Remsen began the publication of the American Chemical Journal, which may be included as part of the work of the laboratory under his direction. Fifty volumes of this journal were published and its influence on the progress of chemistry in this country is recognized to be considerable. It was then taken over by the American Chemical Society.

Prof. Harmon N. Morse

When Dr. Remsen became president of the University he was obliged to relinquish much of the work of directing the laboratory, and after a short period, during which there was no director of the laboratory, Professor H. N. Morse became the second director of the laboratory. With this change the second period in the history of the laboratory begins.

After Dr. Remsen's resignation as director of the laboratory Prof. H. N. Morse was appointed acting director and shortly after, director of the laboratory, and continued director until his retirement in 1917, a short while before his death, Sept. 8, 1920. During this interval almost all the research work carried out in the laboratory was on some phase of one or two large problems. The most conspicuous of these was the work on osmotic pressure begun by Morse in 1901 and continued by Morse and Frazer for many years. During the course of this work a vast amount of accurate data on this subject was accumulated; the osmotic pressure of the sugars was investigated with special care. This work, summarized in a Monograph of the Carnegie Institution, is one of the really noteworthy pieces of experimental research in the history of American chemistry.



PROF. HARMON N. MORSE
1848-1920
Director of Laboratory, 1908-1917, *The Johns Hopkins University*

Reorganization of Department

The resignation of Prof. Morse as director of the laboratory was followed by a reorganization of the department on a more democratic basis. The title of director was abolished and instead a chairman and secretary are elected by the members of the staff at the end of each school year. The administration of the affairs of the department is now cared for by the staff as a whole organized in the simple manner indicated.

At the present time J. C. W. Frazer, B. N. Baker, Professor of Analytical Chemistry, is chairman, and E. E. Reid secretary.

One result of the recent reorganization of the department has been that there has been progress during recent years in much greater variety of research work than had been the case under the former regime. In this connection mention may be made of the work on the vapor pressure of solutions by Frazer and Lovelace, the osmotic pressure of concentrated solutions by Frazer, the work of Reid on catalysis in organic reactions, the work of Patrick on silica gel and related problems, and Frazer's work on low temperature catalytic oxidations.

Johns Hopkins Chemists

The number of Ph. D. candidates in attendance during the past twenty-five years varied from year to year. The average number just before the war was about 35. Within the past few years this number has increased considerably and, lacking the means to increase the teaching staff, plans now are under consideration for limiting the number of students to be accepted for graduate work in chemistry. During the past year there were 52 graduate students enrolled as candidates for the Ph. D. degree.

In the 46 years of its existence 277 students have received the Ph. D. degree in chemistry as their major subject. Of these 122 are at present engaged in educational work, 96 in industrial work, 25 are connected with research institutions, 8 have abandoned chemistry and 24 are deceased. Some of these men occupy leading places in their profession.

A Brief Retrospect

During the first years of its existence the work of the Johns Hopkins University was carried out at its location in a crowded business portion of the City of Baltimore, without campus of any kind. It was always believed by many that this location was temporary, but it was not until 1902 that there was prospect of a more suitable location. At that time a tract of land, comprising about 170 acres in the northern portion of the city, was donated to the University by certain generous friends. This location is in every respect an admirable home for the University, but it was not until some time later that building was begun at the new site.

In 1916 after Gilman Hall, the first of the group of University buildings, and two of the group of Engineering buildings had been completed, it was decided by the authorities of the University that the move to Homewood should be made. By crowding, it was possible to get into these three buildings all departments of the University and the engineering school, with the exception of graduate chemistry. Provision was made for undergraduate chemistry by the equipment of two temporary laboratories, one in each of the engineering buildings. Since the move to Homewood in 1916 the graduate work in chemistry has been carried on in the old chemical laboratory on Druid Hill Avenue, more than a mile away. The many inconveniences of such an arrangement are obvious and the erection of the new chemical laboratory at Homewood will be a great relief to the University. By the removal of the serious handicap under which the graduate work in chemistry has been conducted, it will stimulate greatly the work of this department. A new chapter in the history of chemistry at Johns Hopkins will begin with the completion of the proposed chemical laboratory.

The Building Program

The New Chemical Laboratory

The group of University buildings at Homewood is to be arranged about an open quadrangle. Gilman Hall, the academic building, occupies the western end of the quadrangle; the administration building is to occupy the eastern end and one of the laboratory buildings is to occupy each of the four corners. When complete these six buildings will face the quadrangle and be connected by a brick arcade. The architecture of all of the University buildings is to conform to that of the Carroll mansion, now the Hopkins Club, a beautiful Colonial mansion situated near the entrance on Charles Street.

The chemical laboratory will stand at the northeast corner of the quadrangle, nearest the Hopkins Club, and will face south on the quadrangle. It will be approximately 150 feet front with two wings 130 feet by 44 feet, as shown in the illustration, Figs. 2 and 3. There will be no front entrance to the building, entrance being from the arcade at each side of the front as shown in Fig. 1. It also will be noted that entrance to the building will be on the middle floor and that the building will not be provided with passenger elevators. As the quadrangle is elevated, the laboratory will show but two stories when viewed from the quadrangle; but since the ground in front of the building will be cut away, the laboratory will be three stories high, though having the appearance of but two. The location of the entrances at each side of the front portion of the building determines the arrangement within this portion of the laboratory.

A corridor extends the full length of the front, connecting on the first floor with the two entrances, the arrangement being much as though the arcade were extended straight through the building. On both the basement and second floors is a similar corridor. Stairways are placed in each wing at their junction with the

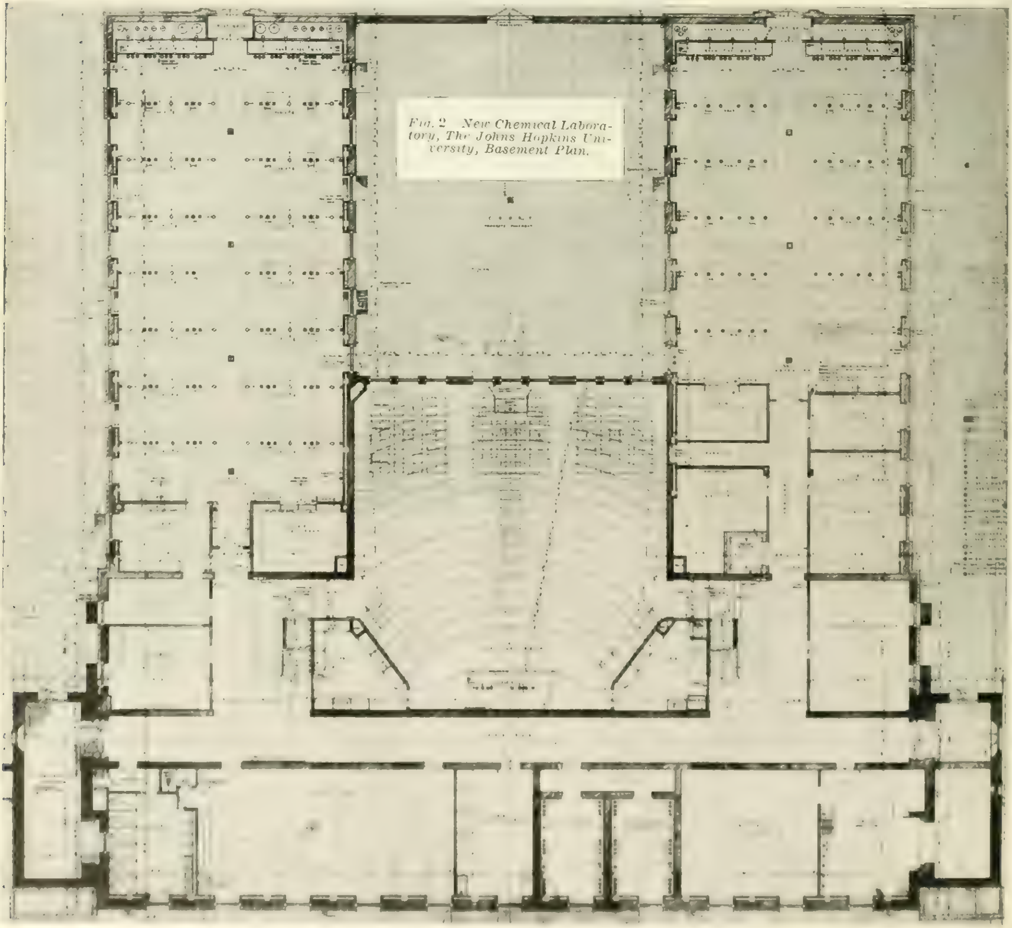


Fig. 2 New Chemical Laboratory, The Johns Hopkins University, Basement Plan.

corridors mentioned, thus permitting the freest possible communication. Storage space is provided beneath the basement floor of the wings and in the commodious attic above.

The building is designed to accommodate all of the instruction in chemistry, both undergraduate and graduate. However, the arrangement of the interior is such that the graduate work is as completely isolated from the undergraduate as possible. This is accomplished by confining the undergraduate work entirely to the basement and first floor, while the second floor is given entirely to graduate work.

Basement and First Floor

It will be noted that the space in the wings on the basement and first floors is taken up largely by large laboratories for the undergraduate instruction, while quiz rooms are provided so that this portion of the laboratory instruction may be handled in groups of about twenty-five. The stock rooms for issuing supplies on these floors are situated just off the main corridor at the entrance to each wing, there being four in all. Offices with private laboratories are conveniently located for the instructors in charge of each of the large laboratories.

The lecture rooms on these two floors are centrally located between the two wings and just off the main corridor. Entrance to the lecture rooms is provided in each wing. With the lecture rooms on these floors arranged one above the other, with the larger one below, skylights are possible in both and the ceiling arrangement within prevents any glare in the speaker's eyes. It will be noted also that the lecture rooms receive only northern light. The larger lecture room accommodates about 250, and the smaller one about 150 students.

Toilets and locker room for the students, storage battery room, shop and constant temperature rooms occupy the space in the front of the building on the basement floor. A portion of the front part of the building on the first floor is arranged for a small portion of the graduate work. At the eastern end there is a small laboratory for organic research and at the western end a room with built-in piers for stability is intended for special research work. In between these two rooms the space is divided into small rooms which may be used as small laboratories, offices or quiz rooms.

Second Floor

With the exception of the two small rooms in the front on the first floor which have just been mentioned all of the graduate work is to be on the second floor.

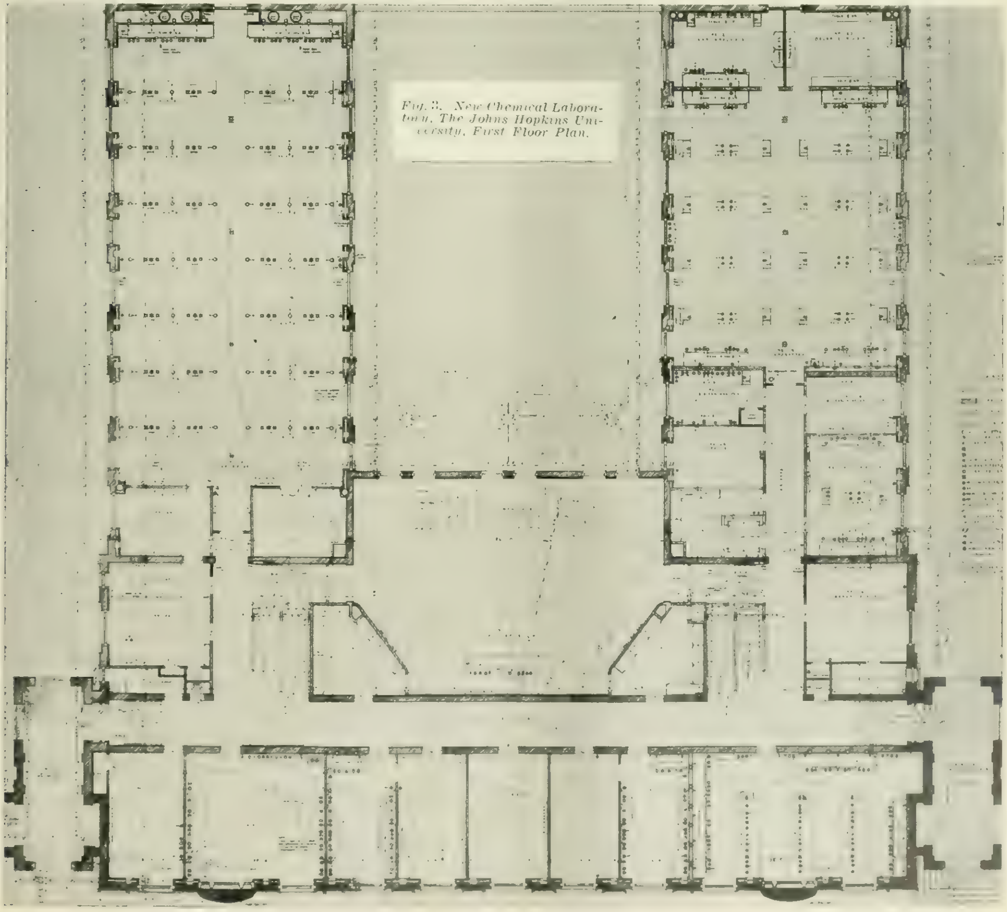


Fig. 3. New Chemical Laboratory, The Johns Hopkins University, First Floor Plan.

Limitations of space do not permit the inclusion of the plan of this floor, on which there are four laboratories each of which will accommodate twelve or more students. These are for routine laboratory instruction in Organic, Inorganic, Electro and Physical Chemistry. Offices with private laboratories conveniently located are provided for the instructor in charge of each of these divisions of the work. In addition each of the instructors in charge will have at his disposal a number of small rooms for individual students and other investigators.

These rooms are approximately 10x15 feet and the arrangements in practically all of these rooms are designed to give the greatest flexibility in their use. The sinks and hoods in these rooms are located at what are considered the most convenient points. The work tables, of which there are several styles, with and without drawers and lockers, are of standard length and may be changed easily or removed entirely as occasion may arise. On the walls of these research rooms wooden timbers spaced about four feet apart extend from the floor to the ceiling. The surface of these timbers extends about an inch beyond the plaster surface of the wall. These will be of great assistance in mounting research apparatus. All pipes and wires are independent of the work tables and are carried on the walls of the laboratory.

The departmental library is located on this floor and directly above the lecture rooms on the floors beneath. Its situation is such that it receives light from the north and its dimensions are quite ample for the purpose. The graduate lecture room is located in the front portion of the building midway of the corridor on this floor, and will have a seating capacity of about 80. Adjoining the lecture room is a room for stenographic work. This room opens into a departmental conference room.

The stock room on this floor is situated near the freight elevator in the eastern wing. The space in the attic is devoted largely to storage of apparatus, but in addition contains rooms equipped for photographic work.

This brief description together with the accompanying illustrations from plans by Carrere & Hastings, architects, New York, will give a general idea of the size and arrangement of the proposed chemical laboratory on which it is understood bids are to be asked in the near future.

American Production of Activated Carbon

THE growth of the research work of the chemical department of the Atlas Powder Co., into the million dollar plant of the Darco Corporation at Marshall, Texas, for the manufacture from lignite of decolorizing carbon adapted to a wide range of uses, is one of the recent conspicuous examples of the capitalization of scientific investigation. This example is notable because it represents conservation and efficiency in their simplest aspects and in intimate combination. Lignite, of which vast deposits exist in various parts of the west and whose recent geological origin has not permitted its transformation into the higher grades of solid fuel, is transformed into a product marketed around $300 per ton, whose use as a clarifying and deodorizing agent in the preparation of many edible and inedible products, makes possible efficiency in numerous industries.

Study of the possibilities of lignite by private and government agencies already has been translated into commercial projects for the utilization of this material in gas manufacture and the elaboration of its by-products. Its use in the form of decolorizing carbon in a wider range of application than is possible with bone-char, certainly represents the widest spread from raw material cost to finished product selling price of any process of utilization of this low-grade material now known.

Properties of Activated Carbon

Arthur B. Day, of the Union Carbide & Carbon Research Laboratories, Inc., in a discussion of the properties, criteria and uses of activated carbon defines this product of lignite as porous carbon material which contains more or less active carbon. Active carbon, according to the hypothesis given by Dr. N. K. Chaney, is a special modification of carbon which is characterized particularly by a very great absorptive power for gases, vapors and substances in true or colloidal solution. It is believed to be formed whenever carbon-containing substances are carbonized at low temperatures, but because of its activity it usually becomes saturated with hydrocarbon during the process of formation. These hydrocarbons may be removed by the oxidizing action of air or steam or by the action of certain chemicals.

The activated carbon prepared from suitable materials and in the proper manner contains a high percentage of active carbon, is structurally strong, has a great number of very small capillaries, and is commercially useful for adsorbing gases and vapors. Both high percentage of active carbon and structural strength are necessary properties. Such a carbon takes up vapors in two ways; it adsorbs them on its exposed active carbon surface by reason of the great attractive force which is exerted, and it condenses them in its capillaries. The vapors condensed in the capillaries have an appreciable vapor pressure and are thus loosely held, but the vapors adsorbed by the active carbon are strongly held and have an extremely small or no vapor pressure at ordinary temperatures. The specific adsorptive capacity of a carbon is therefore of more importance than its capillary capacity, because in industrial application the carbon must completely extract vapors from air or other gases which are present in extremely low concentrations.

The attractive force which active carbon exerts makes it useful for removing coloring matters, other impurities or valuable substances from liquids. But in order that colloidal substances or large molecular aggregates may be removed they must have free passage to the active carbon. Carbon materials which expose a very large surface of active carbon by means of relatively large open pores or capillaries are therefore to be desired for removing such substances from solution.

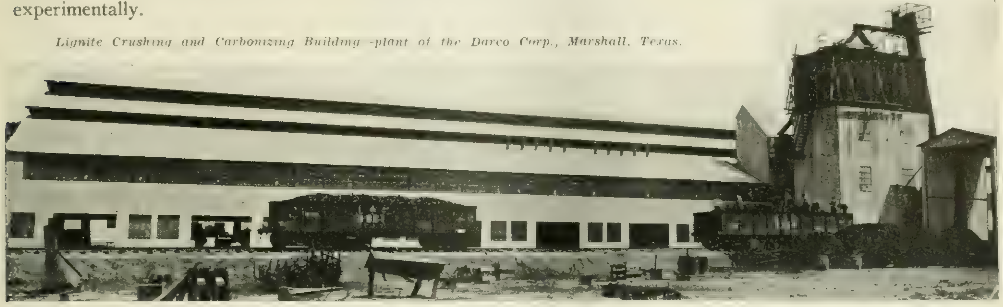
Bone char contains only about 10 percent of carbon distributed on a frame work of calcium phosphate. It was natural, therefore, that the earlier investigators attempted to produce similar material by mixing cheap carbonaceous matter with inert substances, as chalk, flint, pumice, etc., before charring. These admixtures were to serve the same purpose as does calcium phosphate in the bone black, i. e., a skeleton on which carbon particles were deposited. A much greater surface of the carbon is exposed in this way and a more porous structure produced, both of which are important

---

* [illegible]

It is now well known that an increase in decolorizing power may be affected in several ways. First, heating without admixture the vegetable char to a high temperature in the absence of air. Second, mixing the raw material or char with impregnating substances and then heating the mixture under conditions which prevent the oxidization of the carbon. The impregnating substances are then removed in part or wholly by treatment with proper solvents. Third, heating the raw material in a current of steam or certain gases or mixture of gases, the steam or gases serving largely to prevent too rapid oxidization of the charcoal. A great deal of work has been done using sawdust and lime, the lime being subsequently removed by treatment with hydrochloric acid. Magnesium, calcium, zinc and tin chlorides either separately or in combination, have been used as impregnating substances, and a great variety of very excellent decolorizing carbons have been produced experimentally.

Lignite Crushing and Carbonizing Building -plant of the Darco Corp., Marshall, Texas.



Uses of Activated Carbon

The uses of activated carbon fall into three classes as follows:

I. *Adsorption of gases and vapors.* As a gas or vapor adsorbent activated carbon my be used for recovering solvents from air, extracting gasoline from natural gas, obtaining high vacua, purifying helium, deodorizing refrigerators, removing sulfur compounds from coal gas, extracting light oils from by-product coke oven gas, purifying carbon dioxide, removing noxious or toxic vapors from air to be breathed, etc.

II. *Adsorption of substances from liquids.* As an adsorbent for substances in solution activated carbon may be used for deodorizing sugar solutions, syrups, edible oils, petroleum oils, organic liquids, organic acids, mineral acids, waxes, glycerin, gelatin, glue, etc. It may be used for recovering alkaloids and gold from solution. It further may be used for purifying and sterilizing drinking water.

III. *Catalytic.* As a catalyst it may be used in chlorinating natural gas, manufacture of phosgene, oxidation of nitrogen oxides, etc.

In the preparation of decolorizing carbon it is difficult to obtain an efficient product without some addition of mineral matter, possibly because the natural ash constituents at the temperatures necessry in carbonizing tend to soften and to clog the pores, thereby retaining in the capillaries of the primary carbon the charred residue of the products of the original carbonization, which is described as secondary carbon.

Outline of Procedure

In the procedure of manufacturing activated carbon from lignite (although the process is applicable to a wide range of cellulosic materials), as outlined by R. W. Mumford in U. S. Patent 1,286,187*, the lignite is reduced to 10 to 16-mesh size and is freed from all water-soluble matter, whereupon the mass is reduced to a paste by the addition of a milk of starch (1-15% of potato flour or starch) or of 1-15% of gelatinous tri-calcium phosphate, or in combination. Then 5-50% of dolomite (80-100 mesh) is added and mixed to complete homogeneity. The mass is then heated progressively in rotary kilns, vented to allow the escape of vapors. With the expulsion of water, porosity is imparted, the hydrated colloid loses its plasticity and attains a permanent rigid structure; the mass becomes dry and charring then takes place. The charring does not require much heat, and rapid rise of temperature is avoided by the mineral spacing agent which also acts as an inert diluent.

As the vegetable particles char, vapors are evolved and then pass out of the pores, the main part of the charring being accomplished at about 250° C., after which decomposition of the mineral spacing agent begins, the gases from which are taken up in the open pores of the adjacent particles of charred vegetable matter. The temperature meanwhile is increased to 800-900° C., whereupon the material is discharged into water under the exclusion of air. Removal of excess mineral matter is now effected by treatment with acid and by sedimentation or centrifuging. The carbon is then dried and ground to any size required.

In charring the compounded mass rapid evolution of large volume of gas is sought to be avoided as too rapid a reaction at high temperature tends very quickly to destroy the fibrous structure of the mass and the carbon itself.

High absorption properties arise from the large surface area, due to the great porosity imparted by the mineral spacing agent, the reinforcing colloid which possesses a rigid structure on dehydration, and by the evolution of gases capable of affecting the pores.

Commercial Production

Upon the completion, in a small plant at Houma, La., of the experimental work in the utilization of lignite for the manufacture of activated carbon, its commercial production was established at Marshall, Texas, where on an 84-acre tract with ample railroad facilities, convenient access to natural gas and to the company's own lignite land, the Darco Corporation has built the largest plant in the world devoted to the manufacture of activated carbon. From the receipt of the raw material in cars, as shown in the accompanying illustration of the pulverizing and carbonizing buildings, until the finished product is stored in the shipping shed, the operating procedure is entirely mechanical. The plant has a capacity for handling 150 tons of raw lignite daily with a possible daily output of 40,000 lbs. of carbon. Natural gas is used for heating in process work and for steam and power production in a boiler plant of 1500 h.p. Babocck and Wilcox boilers and 600 K.W. turbo-generator.

---

*Issued Nov. 26, 1918, and assigned by Mr. Mumford to the Darco Corporation.

Other units of the plant, which comprises 10 buildings with a total floor area of 66,000 sq. ft., are: The preparation tower for the preliminary treatment of the lignite; the furnace building, over 400 ft. long; the purification building where the retorted mass is activated; drying, packing and storage building; pump house, where water is drawn from driven wells; acid house; and office and laboratory building.

In construction, equipment and in operation, this plant is a foremost example of chemical engineering progress, and in location, representing as it does ready access to fuel, raw materials and shipping facilities to domestic and foreign markets, it represents a high degree of economic coordination of the essentials of commercial success.

Composition Flooring

THE composition flooring industry is declared to possess remarkable latent possibilities considered from the standpoint of present material and labor costs of wood floors. The composition flooring represents an efficient substitute for present high-grade flooring material and is expected to enjoy increasing repute as economic conditions become more favorable to its use. Its basis is the cementing action of a mixture of magnesium oxide and a solution of magnesium chloride discovered by Sorel in 1867. Sorel found that the cementitious power of the mixture was so enormous that it could undergo great dilution with suitable aggregate without great sacrifice of binding strength. Mixed with inert material, as sawdust, the product sets to a hard tough mass.

Classification of Ingredients

The cement and the aggregate, with mineral pigment when desired, make up the ingredients of composition flooring. The cement comprises magnesium oxide and magnesium chloride. Magnesium oxide is obtained by the calcination of magnesite, occurring in this country in California, Washington and Nevada, which, instead of being "dead burned," i.e., having practically all the CO_2 expelled, as is required for use in refractories, it is left "caustic," i.e., with 2-10 per cent of CO_2 retained. The calcined magnesite should be of a fineness that at least 97 per cent should pass 100-mesh and at least 75 per cent a 200-mesh screen. Magnesium chloride is obtained as a by-product in salt manufacture in this country or from the Stassfurt deposits of Europe. It is usually massive or granular, containing about 98 per cent $MgCl_2 6H_2O$ and the remainder chiefly varying propositions of calcium chloride, magnesium sulphate and sodium chloride. The density of the magnesium chloride solution influences greatly the setting properties of the cement, the most satisfactory concentration being around 20° Bé.

The diluent or aggregate may constitute 10-40 per cent of the whole cement and comprises inorganic material as sand, silex or ground quartz, marble or limestone dust, talc, clay, asbestos fibre, etc., or organic material as sawdust, wood flour, pulverized cork, etc. To secure high strength and maximum water resistance, it is essential that the aggregate be finely divided, so that each particle of magnesium oxide may enter into the reaction to form the rather indefinite magnesium oxychloride, $3MgO.MgCl_2 10H_2O$. The setting of Sorel cement does not proceed as does that of Portland cement, when the latter sets the small particles become coated with a shell of reaction products leaving the center unchanged; hence the necessity of thorough mixing. With Sorel cement each particle of magnesium oxide enters into the reaction to form the oxychloride which coats the particles of the aggregate. To permit the voids of the mass to be filled by the oxychloride alone, inferior strength will result as the cementitious material alone is the weakest part of the set mass. Resistance to the softening action of water may be promoted by the use of metal soaps of the fatty acids.

Proportions

The proportions of calcined magnesite (MgO) and magnesium chloride solution used in American practice are not believed to depart greatly from those given by Robert Scherer, from whom the following formulas are quoted:

Mixtures for the underlying or coarser layer.

[Parts by weight.]

1. 15 parts magnesia.
   10 parts magnesium chloride solution, 20° Bé.
   10 parts sawdust.
   (Sets in 36 hours.)
2. 10 parts magnesia.
   10 parts magnesium chloride solution, 28° Bé.
   5 parts sawdust.
   (Sets in 16 hours.)
3. 20 parts magnesia.
   15 parts magnesium chloride solution, 20° Bé.
   4 parts ground cork.
   (Sets in 24 hours.)
4. 5 parts magnesia.
   3 parts magnesium chloride solution, 20° Bé.
   5 parts ashes.
   (Sets in 24 hours.)

Mixtures for overlying or surface layer.

[Parts by weight.]

1. 40 parts magnesia.
   33 parts magnesium chloride solution, 19° Bé.
   10 parts asbestos powder.
   5 parts wood flour.
   1 part red ocher.
   (Sets in 24 hours.)
2. 25 parts magnesia.
   25 parts magnesium chloride, 21° Bé.
   4½ parts wood flour.
   15 parts yellow ocher.
   (Sets in 30 hours.)

The convenience of application of the plastic mixture which sets in a few hours as a tough, seamless surface, holding firmly to wood, metal or concrete as a base, indicates a great field of usefulness as a structural material. Finished with a smooth surface it will take a good wax or oil polish. Its limitations arise where exposed to conditions of permanent wetness, e.g., in the construction of swimming tanks, or to the action of acids and alkalis, as in laboratory floors and table tops. In application it is less expensive than marble, cork, rubber, clay or mosaic tile, slate or terazzo. Its competition lies with wood, asphalt, linoleum and Portland cement. As regards the usual requisites of a flooring material, the magnesium oxychloride cement affords one of the most satisfactory for many purposes such as in kitchen, laundry, toilet and bathrooms, corridors, large rooms or halls in public or other buildings, including factories, hotels, restaurants and railroad cars.

Safety In the Handling and Use of Acids

By Maurice F. Crass
The Grasselli Chemical Company

ACID may be likened unto fire in that it is a good servant but a dangerous master. There is a good deal of misconception regarding acid plants in the mind of the ordinary citizen who associates it with an evil smelling place, to be heartily avoided. But to the acid man it is one of the healthiest of places and the acid man is seldom sick with a germ disease. As for the smell, well, he won't admit there is any, yet he will—if he stays away from the plant long enough—become homesick for it.*

The fire comparison is an apt one, for it is very true acids can be handled with perfect safety by those having knowledge of their character. The resistance of various materials and metals to the action of the acid must be known, otherwise the element of danger in handling will be increased, to say nothing of excessive deterioration. It is not safe for novices to mix acids or combinations of chemicals, for many acids and chemicals, harmless in themselves, become deadly when mixed as was evidenced recently when a Cleveland high-school lad was fatally burned while experimenting with mixtures of which he had no certain knowledge.

MAURICE F. CRASS
The Grasselli Chemical Company

Acid Containers

The question of containers is inseparably linked with our subject, for it is only by the use of the best approved types of containers that maximum safety is obtained. Tank cars, drums and carboys may be considered in their turn. In loading tank cars the matter of outage, or free air space, in the tank is important. Sixty-degree acid expands in volume .0312 per cent per 1 degree Fahrenheit. A 20-degree variation in acid temperature on a 100,000-pound tank will require an outage equivalent to 624 pounds acid, otherwise acid will be forced out of the tank through the rupture of the safety disc; or if no such vent is provided there is danger of the bursting of the tank. In either case there would be danger present to railroad and industrial employees. We wish also to call attention to a recent explosion where a mixed-acid tank was blown up with extreme violence and two men killed. Inasmuch as mixed acid does not detonate and is a safe commodity to ship in a proper container, this accident resulted is an investigation which developed that the tank had been previously used for the transportation of spent acid. The mixed acid was not a factor in the explosion.

Safe Practices Applied to Tank Cars

Several instances have come to my attention of late where instructions governing the pressure applied for the discharging of tank cars were not observed. In one case, in the East, a tank car was reported leaking badly on the road and an investigation developed the fact that the consignee on a prior movement applied at least three times the pressure permitted. Another recent case was reported where the dome cover was blown off the tank and hurled high in the air; the retaining lugs were torn loose, due to the application of double the pressure permitted. Many consignees unload tank cars by hitching the air connection to their air main which in many instances is kept under a pressure of from 80 to 100 pounds, the only regulatory appliance used being a cock which in known instances was not adequate protection against undue pressure. Thirty pounds pressure should be sufficient to discharge any tank car and if it will not a pump should be used.

Careful attention should be given to the proper placement and condition of dome gaskets. If leakage results under pressure the pressure should be released and the gasket reset before continuing with the unloading.

Accidents more or less serious have been caused by a lack of protection to men loading and unloading tank cars. The rounded surface of the tank affords insecure footing for a workman taking off and replacing a dome cover during the course of loading a tank. This danger is intensified during wet and frosty weather, the presence of snow or ice on the tank sheets, etc. Even when weather conditions are good a little sloppage of some kinds of acids makes a slippery base and the best protection to the workman is none too good for this work. Some concerns have adopted a stationary platform around the dome; this has its advantages and disadvantages. Another contrivance is in the form of a lift platform which, when lowered into place rests on the tank sheet, serves as a walkway from the loading rack to the open dome of tank car, it also gives the required platform protection. The observance of these precautions both in the loading and unloading of tank cars will go a long way toward reducing accidents for this operation to the minimum.

Drums

The standard twelve-gauge 110-gallon drum approved by the Bureau of Explosives can be handled and shipped with entire safety. Expansion of acid in this tight container should always be provided for by leaving at least 3 inches of air space under the drum plug. The plug should be loosened sufficiently at destination to release any pressure which may be present—a half-turn is usually sufficient. Cases have been known where drums have been stored in hot working rooms, without this precaution being exercised, resulting in the blowing up of the container with more or less disastrous results. Drums in the ammonia and other services carrying liquor of a more or less high volatility require careful attention in this respect.

---

*A paper presented at the 11th Annual Safety Congress of the National Safety Council, August 28-September 1, 1922, Detroit, Mich.

Before repairing acid drums they should be carefully washed out with water or, better still, with an alkali solutions. No open flame should be used in connection with repairs until all acid contained is thoroughly neutralized, otherwise the generation of hydrogen gas within the drum is likely to cause an explosion.

Carboys and Acid Storage Tanks

There is now a porous earthenware stopper on the market which releases pressure as fast as it accumulates and thus the danger of the blowing up of a carboy with a sulphated seal is avoided. A hand-operated syphon now can be procured which is entirely safe for drawing off small quantities of acid from carboys. All carboys when emptied should be carefully drained. The non-observance of this rule has caused many accidents.

All sulphuric acid storage tanks should be equipped with bottom outlet tapered plugs in addition to the outlet control cock. The latter has been known to give way and if a control plug is not present serious loss of acid may be suffered with the attendant danger to workmen.

Many tanks are equipped with pump connections for drawing off acid to elevations. When repairs to these pumps are necessary care should be exercised to keep naked flames away, for the generation of hydrogen gas in the acid end has been the cause of more than one serious accident.

Stuck cores in acid cocks, whether of earthenware or of duriron, should be opened with great care. The usual procedure is to tap the core; many serious burns have resulted through the first not being equipped with clamp and bib to prevent the core from jumping and spurting acid in the operator's face; the latter should also be equipped in like manner.

Nitric Acid Fumes

When a carboy is broken, brown fumes are liberated; workmen should keep out of this gas zone. Let the acid go to waste but keep the workmen away. If water in quantity is available, turn a hose on the leakage, the more used the better. If a workman is known to have inhaled any of the fumes he should be kept under close observation and, better still, put in charge of a physician for the first twenty-four hours—any danger will pass in this time. Take no chances with such cases.

This danger is emphasized for the gassing symptoms may not develop for hours after exposure. The same symptoms should be guarded against if it becomes necessary to enter sulphuric or mixed-acid tanks. It is not safe to permit a workman to enter a tank until it has been thoroughly flushed out with water and even then it is good practice to wear a gas mask with a canister especially suited for the purpose. A volume could be written on the use of respirators and gas masks, some types of which are useful and some are useless, each special case would necessarily have to be treated or considered separately.

Acid Lines

All acid lines in plants should be inspected at regular intervals. The overhead line should be as free from sharp bends as possible (swing ells are best) and are preferable to buried lines. They last longer, drain better and no danger need be feared from them if kept in good condition. Weak or badly corroded lines should not be allowed to exist. It is patent that any pressure line in poor condition is dangerous—especially an acid line. All soap or acid soaked earth should be dug up and replaced with fresh soil or sand. A workman slipping in acid-soaked soil may suffer a severe burn or eye case. If soil cannot well be removed, neutralize with milk of lime or soda ash.

No repairs should ever be made to an acid line without the connecting valves being tightly closed and locked and guards for this purpose should be installed on all controlling valves. Insist on rigid periodic inspections (daily when apparatus is in use) of all acid lines and apparatus. Especially guard against overhead leaks.

Fumes arising from pickling vats are a nuisance but one not dangerous and preparations are on the market which largely reduce this trouble. The question of how a man should be cared for when splashed with acid cannot be answered by a general prescription.

Acid Burns Require Prompt Attention

Muriatic acid can be washed off readily with water. Sulphuric acid, especially the higher concentrated forms, may cause very bad burns. If the contact is slight, wiping off the acid with a rag or piece of clothing can be followed with water application. Where the patient is sprayed over with acid in quantity the excess should be quickly wiped off, tear off the clothing as quickly as possible and use the clean parts for wiping, then follow with a copious supply of water. If the washing is attempted before removing clothing or insufficient water is used, the chemical heat generated by the admixture of acid and water may and in many cases has produced very severe burns. The washing is promptly followed by the application in liberal measure of some neutralizing healing agent. Nitric acid is in a class by itself and because of the nature of the burns caused—scarring of tissue and difficulty in healing—should receive the most prompt treatment. Washing of the afflicted part with water, followed by the application of a neutralizing and healing ointment, is the accepted procedure, but this is first aid only and such cases should be put under the care of a physician as promptly as possible.

Goggles

No article on the handling of acids would be complete without emphasizing the necessity of wearing goggles at points where there is any liklihood of the splashing of acid. Men cleaning containers or dipping acid therefrom, and mechanics engaged in repairs to lines and other acid-conveying apparatus should be compelled to wear goggles on penalty of discharge. If indeed a man's eyes are the windows of his soul, verily he should guard them zealously—yet one of the hardest rules to enforce in a chemical plant (and I suppose in other plants) is the wearing of goggles when there is a possible hazard present

---

Organized in 1912 the National Safety Council grew from a small body of engineers to its present membership of 4,000 members, who operate 8,000 industrial plants and employ more than 7,000,000 workers. The United States has taken the lead for safety in industry.

* * *

Soap manufacture, as a chemical industry, represents in its development a characteristic shared more conspicuously by the mechanical industries, e.g., boots and shoes, in the progressive reduction of the number of producing units, with increased volume of aggregate output, and the increasing proportion of the output being made by the larger units. For example, in 1880, there were 629 separate soap manufacturing plants; in 1890, 578; in 1900, 558; in 1904, 436; in 1909, 420; in 1914, 371; in 1919, 348. Total production in short tons increased from 715,255 tons in 1904, to 1,216,295 tons in 1919.

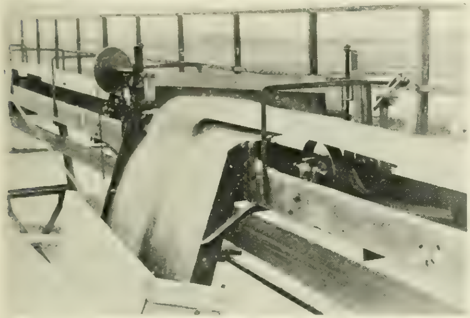
The Steel Belt in Material Handling

By Harry Carlson

Sales Manager, Sandvik Steel Co., Inc.

BELT conveyors for handling raw materials and materials in process of manufacture and the finished product in loose and packaged forms have become standard equipment in all plants where the volume of production will admit an operating profit when the belt is used, and the installation is such that the belt can be kept in use sufficiently to liquidate its first cost within a reasonable time. Belt conveyors have demonstrated their utility for handling a great variety and form of materials between extremes of 10 and 1,000 feet under conditions that require the steady flow of the material.

In the development of this type of conveyor the character of the material handled has determined the structure of the belt. Durability as evidenced by long service has influenced the selection of material, which has ranged from canvas to the impregnated rubber fabric belt of various kinds and to wire cloth of varying mesh. The severe treatment accorded the earlier form of belt in handling heavy, coarse or abrasive materials called eventually for a high degree of durability, which has been met by the introduction of the steel belt in whose use may be recognized the mechanical principle of the bandsaw. In the handling of warm, viscous, or abrasive materials where much trouble has been experienced with the rubber-impregnated fabric belt, the steel belt conveyor has been found especially suitable; its advantages over apron conveyors and woven wire belts being especially notable in the elimination of heavy maintenance costs, power consumption and spilling of material carried through joints and interstices.



Loading crude potassium chloride on the steel belt conveyor.

In addition to the transport of coarse, heavy materials as coal, coke, ores, clay, cement, sand, lumber, etc., and packaged goods of varying shape and size, the steel belt conveyor has been used in Continental practice in many branches of the chemical industry under conditions that make the use of less durable material impracticable. Such materials as calcium carbide, potash salts, asphalt, ammonia soda, sugar, beet pulp, dried milk, yeast, cocoa products, ore concentrates, and numerous other products at varying temperatures, are transported with a minimum cost of service.

The steel belt conveyor is a European product of Swedish charcoal steel, with a carbon content of about 0.65 per cent, cold-rolled, hardened and tempered, and made in lengths up to 350 feet, in widths up to 16 inches and in thicknesses up to 0.04 inch. The flexibility of the steel belt may be judged from the fact that a coil of 300 feet of 16 in. belt is contained in a case of 2 ft. x 2 ft. x 1½ ft., weighing approximately 2 lbs. per running foot. Resistance to rust is acquired by special methods of heat treatment, hardening and tempering; durability under severe treatment comes from the hard, smooth and dense surface. Naturally the steel belt is not applicable to the transport of acidulous material or any soluble sulphuric acid salt which in the presence of moisture will react with iron, notwithstanding which, however, installations in the fertilizer industry indicate its suitable use.

The steel belt admits of a greater simplicity and cheapness of installation than is possible with belts of inferior transverse rigidity. The conveyor may be designed in two ways, viz., (1) with the conveying strand sliding on a wooden support, sometimes fitted with skirting boards, trough-like, the return strand being supported on idlers, or (2) both strands of the band are carried on rollers in the usual fashion. The former type, with or without skirting boards, is used for conveying non-abrasive material. Next to no wear is suffered in this type, even for conveyors of considerable length, as the surface of the runners soon acquire such a polish that the friction and consequently the power consumption is almost negligible. As compared with flat rubber belts of the same width, the steel belt possesses greater transverse rigidity and therefore a higher capacity, as the edges, even with a one-sided load, do not yield in a downward direction. This allows a relatively broader part of the belt to be used for carrying the load. These attributes are due to the fact that the steel belt is less flexible than the textile fabric.

Steel belt conveying beet pulp undergoing discharge by means of scraper.

The joint is an ordinary riveted lap joint with short overlap, and can be made complete in less than an hour. Countersunk rivets are used. For punching the holes a special tool is supplied which makes the jointing work extremely simple. It has been found after extensive experiments with many different kinds of joints that the one herein mentioned is the simplest, most efficient and cheapest.

The speed of the steel belt depends on the length of the conveyor, varying between 135 and 300 feet per minute, which determines its capacity. The average speed for the average length conveyor is about 200 feet per minute. Inasmuch as the steel belt does not stretch, simple tension devices are necessary only for taking up trifling variations in length arising from changes in temperature. The flat and smooth surface of the belt admits of easy and clean discharge at any desired point without the use of cumbersome trippers. Inclines vary somewhat with the material being handled. In a general way, a figure of 1 in 4 is the limit for a smooth belt which has to be scraped off for unloading, but if terminal unloading only is to be used, slats can be affixed to the belt at intervals and the incline increased to about 1 in 2.75, which proportions will allow use of the steel belt in places for the elevation of material.

Current Chemical Patents and Patent Problems

A CHEMIST engaged in research or manufacturing at times questions the advisability of patenting his discoveries when he realizes that it would be necessary for him to disclose to the public the specific and preferable way for carrying his invention into practical effect. He may feel that safety lies in maintaining his discovery a secret, since its publication may lead others to secret and probably undetectable infringement. He consequently considers the advantages and disadvantages of maintaining his invention a secret rather than securing patent protection. The question hence arises as to what rights the owner of a secret invention may have and what are the dangers incurred.

Everyone has a natural right to practice any invention or discovery that he may make unless that right is abridged by a patent or by public policy. The grant of a patent extends to the patentee the exclusive right to the use of the invention or discovery set forth therein, but in order to obtain this exclusive right, the patentee must disclose his invention in the patent in such a manner that those who may be considered as skilled in art may have sufficient knowledge to practice it. On the other hand one who practices an invention in secret does not and cannot expect to have such a right to exclusion, and for such protection as he may expect, he must look to entirely different principles and rights. This arises out of the conditions surrounding the practice of the secret invention as well as the very nature of the secret invention itself.

The secrecy, which may be attached to an invention, must be secured either by preventing others from having access to or securing the information concerning the operations of the inventor, or by giving the details of the invention in confidence to others who in turn will actually practice in secret. In the former case, the inventor has only himself to blame if the invention becomes known to others excepting perhaps when the information is obtained through fraud or theft. When, however, he has placed confidence in others and they betray this confidence by divulging to others the invention or by themselves attempting to profit by operation thereunder, then it may be considered that the inventor is justly entitled to protection against the breach of confidence or trust. Cases of this character have been frequently adjudicated and in practically every case reported involving the trade secret, the circumstances surrounding have been those of the latter character.

It is practically an impossibility to maintain an invention in secret by either of the aforementioned methods, and the advantages accruing from the protection of an invention through the patenting of it truly appear to predominate.

Increased Value of Trade Mark Registration

That the registration of a trade mark may afford greater protection to the registrant against importation of articles which may bear the same or similar mark, seems to be assured if an amendment, which has been recently introduced by Senator Sutherland, of West Virginia, is enacted as law. This amendment provides for more stringent application of trade-mark rights with respect to imported articles, and is given in full as follows:

"Section 526. (a) That it shall be unlawful to import into the United States any merchandise if such merchandise, or the label, sign, print, package, wrapper, or receptacle, bears a trademark registered in the Patent Office, by a person domiciled in the United States, under the provision of the Act entitled "An Act to Authorize the Registration of Trademarks Used in Commerce with Foreign Nations or Among the Several States or With Indian Tribes, and Protect the Same," approved Febreguary 20, 1905, as amended, if a copy of the certificate of registration of such trademark is filed with the Secretary of the Treasury, in the manner provided by Section 27 of such Act, and unless written consent of the owner of such trademark is produced at the time of making entry.

"(b) Any such merchandise imported into the United States in violation of the provisions of this section shall be subject to seizure and forfeiture for violation of the customs laws.

"(c) Any person dealing in any such merchandise may be enjoined from dealing therein within the United States or may be required to export or destroy such merchandise or to remove or obliterate such trademark and shall be liable for the damages and profits provided for wrongful use of a trademark, under the provisions of such Act of February 20, 1905, as amended."

Sinister Alien Influences

History repeats itself. A few years ago we became acquainted with a most subtle and insidious propaganda fostered and abetted by a foreign influence. The latter years of the war and those immediately following saw this propaganda revealed so that every one was able to recognize its source and purposes, and hence it became impotent. However, most of us now find our thoughts trending away from the lessons of those years, and in this trend there links a grave danger to the chemical independence of this country. The same subtle and insidious influences, which do not consider the means to the result, but only the result, are again active and tend to permeate every fibre of national activity.

Domination of the chemical industry is the goal, and as this depends upon a control of the patent situation it is sought to secure covering patents. This is evidenced by an examination of the assignment records of the Patent Office which show hundreds of applications filed and assigned to corporations as Badische, Bayer, and Meister Lucius and Bruning or in other words the I. G.

Applications also have been filed for an invention covered by a previous application of the same inventor, the previous application having passed into American ownership. One such application was inadvertently passed to issue and a patent granted thereon. A fraud was attempted and the attempt was successful, but certainly not any court will hold a patent obtained under such conditions as valid.

The American manufacturer must remain fully fully awake to these sinister machinations and must strive to thwart them by securing patent protection for his developments or improvements without delay.

Unprecedented Patent Business

A report showing the receipt of applications for the fiscal year ending June 10, 1922, states that there were 113,587 applications for patent and registration of trade-marks, an advance of more than 6,000 over the totals for the previous year. This is the greatest volume of business which has ever come before the Patent Office in any year and has made unusual demands upon the force which already has been considered as inadequate. A part of this unusual volume of business may be attributed to the filing of a considerable number of foreign applications, which were not filed because of conditions during the war and immediately thereafter, but indications seem to point that there will not be a very marked decrease in the number of applications filed for a considerable period.

Commissioner Thomas E. Robertson candidly admits that the Patent Office has an accumulation of more than 70,000 applications for patents. More than 6,000 petitions for trade-marks are awaiting action. So far behind has the bureau fallen in its work that Commissioner Robertson states the forty-nine technical examining divisions would require from three to fourteen months to catch up. Due to the loss of trained examiners and the vacation period, he declares that the bureau has lost ground during the past few months, but predicts that, starting in October, gains will be made. Applications are coming into the Government in a volume that eclipses all previous records.

The Lambert Act, which sought to meet the inadequate facilities in the Patent Office, did not grant an amount of relief which will enable the Patent Office to give the volume of business before it the consideration which is necessary. The manner in which every available portion of the corridors in the Patent Office are now being used as annexes to the various divisions evidences clearly the necessity for remedial measures. It is to be urged that the overcrowded conditions and the undermanned force be brought forcibly to the attention of Congress, to the end that just and proper remedial measures may be enacted.

Tartaric and Related Acids from Starch

Tartaric acid is widely distributed in nature, chiefly in the juice of the grape, from which it deposits after fermenation as crude acid potassium tartrate or argols, which always has been imported. Allan F. Odell, of Brooklyn, N. Y. (U. S. Pat. No. 1,425,605), has devised a process for making it and other homologous acids from starch and related carbohydrates by oxidation with nitric acid in the presence of a catalyst as the acids, salts or oxides of vanadium, molybdenum and of the so-called rare earths. In the course of the oxidation, in addition to tartaric acid, saccharic and other related acids are formed, as well as oxalic acid. The proportion of these products or the predominance of any one may be determined by the use of a substance which serves to inhibit the production of a given acid or to promote the production of another, e. g., manganese oxide and compounds of nickel, iron and cobalt.

The procedure is illustrated by an example, to wit: 400 grams of starch, made into a paste with 2,000 grams of water, are mixed with 1,900 c.c. of nitric acid, sp. g. 1.33, 0.5 gram of vanadic acid or a mixture of that with 0.5 gram of molybdic acid, and 10 grams manganese oxide which is claimed to promote the yield of tartaric acid. The mixture is heated gradually in a vessel suitable for conducting off the evolved vapors until the reaction commences, i. e., about 90° C., when the temperature carefully controlled should not exceed 115° C. Two hours suffice for the oxidation. The product is a solution of oxalic, tartaric, saccharic and other allied acids. On cooling to 2-3° C. the oxalic acid largely separates by crystallization. The separation of tartaric from saccharic and related acids in the filtrate involves dilution, heating and neutralization with lime and successive crystallization.

The tartaric acid thus obtained may be, and usually is, a mixture of isomeric tartaric acids containing the ordinary dextro-tartaric acid with the inactive racemic acid, or meso- or possibly meta-tartaric acids.

Cellulose Butyrate

Cellulose nitrate and cellulose acetate are well known for their uses in plastics, lacquers, etc. Cellulose nitrate has the disadvantage that it is highly flammable, but in spite of this hndicap it finds a wide range of usefulness. Cellulose acetate has the disadvantage that it is soluble only in special solvents. Although forms of cellulose acetate have been described which are soluble in hot mixtures of alcohol and benzol, the solutions which they yield gelatinize when cooled to room temperature.

G. J. Esselen, Jr., and Harry S. Mork, Boston, Mass., have discovered a new form of cellulose ester, cellulose butyrate, which is superior to both cellulose nitrate and cellulose acetate. Unlike cellulose nitrate, it is not highly flammable; its particular advantage over cellulose acetate lies in its ready solubility in inexpensive solvents. It readily forms fluid solutions in a mixture of alcohol and benzol even at ordinary room temperatures.

Cellulose butyrate has a wide variety of uses, e. g, in the manufacture of plastics, transparent sheets and films, artificial silks and filaments, lacquers, airplane dopes, artificial leather, etc.

Its manufacture (U. S. Pat. No. 1,425,580-1) comprises a preliminary impregnation of the cellulosic material, which may be cotton roving, yarn, linters, rags, etc., or wood pulp, paper, etc., with a catalyst, as sulphuric acid, using as a carrier the organic acid of the ester to be produced, i. e., butyric acid, together with a suitable solvent as denatured alcohol which serves to prevent the separation of butyric acid and sulphuric acid into layers in the presence of water. The ingredients of the impregnating bath comprise by weight: 0.5-0.6 per cent 1.84 sulphuric acid; 5-7.5 per cent 188-proof denatured alcohol; and 92-94 per cent butyric acid. For impregnation in such a bath 90 minutes suffice, after which the sulphuric acid is thoroughly removed. The impregnated cellulose is now acylated by treatment with butyric anhydride and butyric acid in the proportions of 100 parts by weight of cellulose, calculated on the untreated cellulose, to 465 parts of 90 per cent butyric anhydride and 400 parts of butyric acid. The product prepared in these proportions is soluble in chloroform, acetone, ethyl acetate, 90-per cent carbolic acid, hot denatured alcohol, hot benzol, hot solvent naphtha, and at room temperature in mixtures of alcohol (methyl or ethyl) and benzol, containing 50-95 per cent of the latter. It is not soluble in normal butyl alcohol solvent naphtha, or carbon tetrachloride at room temperature.

Antimony Trichloride

It is well known that chlorine will react strongly with metallic antimony either in presence or absence of water; but it has not heretofore been found practicable to utilize this reaction for the commercial manufacture of aqueous solutions of antimony trichloride. Clyde E. Williams of the Hooker Electrochemical Co. has demonstrated the applicability of this reaction to commercial production and outlines the procedure in U. S. Pat. No. 1,425,565.

Metallic antimony, conveniently in the form of 1/32 to ¼-in. fragments, is charged into an upright cylindrical earthenware vessel or reactor, and is completely submerged in a solution of hydrochloric acid, preferably of 15°-15.5° Bé, the latter in sufficient concentration to prevent substantial separation of oxychlorid compounds by hydrolysis. The charge of metal should be sufficient to fill the vessel to about one-half of its depth or somewhat less; and the lower half of the vessel at least should be watercooled by standing one or several of these reactors in a tank or trough of running water. The acid may fill the reactor nearly to the top. The chlorine gas, preferably diluted to approximately 50-per cent concentration by air, is introduced into the bottom of the reactor beneath the bed of metal, the flow of gas being regulated to maintain the temperature of the solution above normal but below about 60° C. An operating temperature approximating 60° C. is preferred. The air in the gas mixture serves both to moderate the reaction and to stir the contents of the reactor; it should be so adjusted as to avoid substantial losses of hydrochloric acid at the operating temperature and concentration.

Chlorination is continued under these conditions until a solution of about 45-50° Bé. is obtained. The flow of chlorine is then stopped and the bulk of the liquor drained off from the residual metal, a sufficient amount being left to initiate the succeeding reaction cycle. Additional metal and acid are then added to restore the original proportions, and the operation is repeated.

Selenium Oxychloride to Activate Charcoal

Prof. Victor Lehner, of the University of Wisconsin, Madison, Wis., and Frank M. Dorsey, of Cleveland, Ohio, have patented the use of selenium oxychloride for the preparation of activated charcoal, which application represents a commercial use of the remarkable solvent power of this agent. The usual method of producing activated charcoal is to subject ordinary charcoal to the action of steam at temperatures of 700-1100° C., which involves steam production and heat generation with the product only partially purified and with a degree of porosity far from what is most desirable. The method proposed by Messrs. Lehner and Dorsey admits of temperatures below 100° C., with the resultant product of highly superior porosity, and is applicable not only to charcoal but to ordinary coke and similar carbonized materials as retort carbon, lampblack, petroleum cake, etc.

It has been found that the solvent action of selenium oxychloride ($SeOCl_2$) may be greatly intensified by the addition of 10 per cent of SO_3 with the result that many substances are dissolved upon which selenium oxychloride alone has no action. On the other hand the solvent action of the baths alone may be moderated by the addition of a diluent such as carbon tetrachloride, chloroform, benzol or toluol. In carrying out the process (U. S. Pat No. 1,423,321) the carbonized material may be subjected directly to the solvent action of the selenium oxychloride, either alone or intensified or moderated as circumstances may determine, to effect removal of the impurities. The carbonized material may be heated in a closed vessel and vacuum applied to expel the air and the selenium oxychloride introduced, whereby better penetration is assured, especially when the carbonized material is in large pieces. In activating carbonized nut shells, preferably granulated to 10-20 mesh, the material is immersed completely in selenium oxychloride for 1-10 hours, 2 hours ordinarily, however, being sufficient, whereupon the solution is drained off and the material thoroughly washed with carbon tetrachloride, which is recovered for re-use, and that remaining in the material is expelled by heating. Selenium oxychloride boils at about 176° C. The volatile solvents of selenium oxychloride do not possess the power of the latter to dissolve out the impurities of carbonized materials, but serve well as a wash to effect its complete removal.

Waterproofing Asbestos Cement Shingles

Richard V. Mattison, of the Asbestos Shingle, Slate & Sheathing Co., Ambler, Pa., makes asbestos-cement products impervious to water by incorporating in the asbestos-Portland cement mixture about 5 per cent of the weight of cement, of crude petroleum or certain heavy distillates therefrom. The proportion of cement varies from a third to a half by weight of the total dry mixture. The asbestos [illegible] proportions of short fiber and finely divided material. To the thoroughly [illegible] about [illegible] per cent of water is added, this amount being sufficient to saturate it. The oil is now incorporated by means of a pug mill and permits the working of the soft plastic mass [illegible] and without interfering with the bond between the cement, the fiber and water. The wetted mixture is then pressed into the desired shape through a suitable die by means of an auger machine. Incorporation of the oil imparts a smoothness and homogeneity which prevents the disruption of [illegible] further worked and pressed, preferably under pressure, to remove any excess water and to impart a finish, after which it is allowed to set in final form, usually under pressure. Mr. Mattison claims (U. S. Pat. No. 1,423,000), that the product is a compactly pressed material homogeneous at all points and of even strength throughout without any weakened spots due to relative shifting of the particles. The oil, being thoroughly mixed into the composition before the cement is set, becomes integrally incorporated in the hardened material and tends to render it permanently waterproof.

Chlorinating Gaseous Hydrocarbons

George A. Curme, Jr., chief chemist, Union Carbide & Chemical Corp., has devised a process of chlorinating hydrocarbons, such as yield substitution products with chlorine or other halogens, and of separation and recovery of the reaction products, by liquefaction methods comparable to those applicable to the separation and recovery of the components of the air or other mixtures of the so-called fixed gases. Of the hydrocarbons susceptible of halogenation in the gaseous phase, to which the process is applicable, Mr. Curme selects methane to illustrate the process. While the general procedure of chlorinating methane or gases rich in methane has been carried out by many investigators under a great variety of operating conditions, Mr. Curme has demonstrated (U. S. Pat. No. 1,422,838), that the four following reactions may be made to proceed smoothly with the absence of explosive side reactions:

$$\begin{array}{llll}(1) & CH_4 + Cl_2 & \rightarrow & CH_3Cl + HCl \\ (2) & CH_4 + 2Cl_2 & \rightarrow & CH_2Cl_2 + 2HCl \\ (3) & CH_4 + 3Cl_2 & \rightarrow & CHCl_3 + 3HCl \\ (4) & CH_4 + 4Cl_2 & \rightarrow & CCl_4 + 4HCl\end{array}$$

By proper control of the proportion of chlorine used any of the desired reactions may be made to predominate, although in no case, with the possible exception of the formation of carbon tetrachloride, does any single reaction proceed to the exclusion of all others; in every case certain quantities of all the other theoretically possible products are formed. When carbon tetrachloride is the desired product a practically theoretical yield may be obtained by using a sufficient excess of chlorine, while in the case of any of the other derivatives greater care must be exercised in the use of the proper proportions and in the control of reaction conditions. Ethane or the higher paraffins lend themselves much more readily than methane to substitution by halogens, hence their presence when methane derivatives are desired means undesirable use of chlorine in the production of per-chlorinated derivatives together with equivalent quantities of hydrochloric acid.

Examination of the above equations shows that hydrochloric acid is one of the principal products of the reaction, recovery of which is necessary in order to operate economically. By the usual procedure this involves the rather difficult absorption in water and results in the introduction of moisture into the gas mixture, thereby rendering it unfit for direct re-use in the chlorinating process; also methyl chloride, being very volatile (B. pt.—24° C.), is difficultly condensed from the large excess of methane, even after the removal of the hydrochloric acid, and is, therefore, either partly wasted or is returned to the system and undergoes chlorination to a higher stage. Inasmuch as the lighter chlorinated derivatives ordinarily are of greater commercial importance, a high yield and good recovery of methyl chloride and of methylene chloride are the chief desiderata in the successful operation of the process. In carrying out the process methane is first isolated from natural gas or any of the various industrial gas mixtures by liquefaction and rectification in columns of the Linde type, and is then mixed with suitable proportions of chlorine, according to the predominating product desired. The mixture is then passed at elevated temperatures over activated carbon prepared by the Chaney process. The prime requirement of absence of moisture permits the operation to be carried out in iron or steel apparatus.

The operation is cyclical in character, in the sense that methane, substantially undiluted by nitrogen or other gas, is repeatedly circulated through the system including the catalyzer; the chlorinated products including the hydrochloric acid being substantially separated from the gas mixture at each repetition of the cycle. Dry methane and dry chlorine are constantly supplied to the reacting system in the desired proportions, these gases, with a large excess of methane being then continuously circulated through the catalytic chamber, thence through a water cooled con denser where heavier reaction products such as chloroform and carbon tetrachloride are partly condensed; then compressed to several atmospheres pressure, and led through a heat exchanger into a liquefaction and rectification tower of the Linde type. In this tower the temperature is such that substantially all of the substances present with the exception of the methane (together with any nitrogen or air which may be incidentally present as impurities) are condensed and retained as a liquid mixture, the excess methane alone being carried in gaseous phase through the heat exchanger and used again in the same operating cycle. This procedure is made possible by the extremely low boiling point of methane (—165° C.) which is materially lower than that of any other component of the original reaction mixture. Small quantities of hydrochloric acid (B. pt.—80° C.) may carry through with the methane in gaseous form, but this is generally unobjectionable, since the concentration is not large and cannot build up beyond a small equilibrium point.

The liquid mixture retained contains the following substances in varying proportions, to wit:—

	Boiling point.	
Hydrochloric acid	—80° C.	
Methyl chloride	—24° C.	
Methylene chloride	+42° C.	
Chloroform	+61° C.	traces only.
Carbon tetrachloride	+78° C.	

This mixture may then be subjected to fractional separation and rectification to obtain each component in a pure state; or the mixture may be allowed to evaporate, the vapors being led through water, and the (now concentrated) hydrochloric acid absorbed to form commercial muriatic acid. The residual chlorinated hydrocarbons may then be collected and separated to recover each in a state of purity. The first of these procedures is now regarded as the more desirable, since it offers the possibility of producing liquid anhydrous hydrochloric acid, capable of being stored in steel cylinders, as a new article of commerce

To Prevent Bleeding of Mineral-Tanned Leather

In tanning with the usual iron salts, as ferric chloride, or sulphate of iron, it has been noticed that the leather, if it is treated with water, after it has been tanned, will allow the tanning principle to exude from the grain. This appearance is known as "bleeding," whereby the grain becomes defective, and the leather, being insufficiently tanned, becomes hard.

To prevent this bleeding, the leather, after it has been allowed to remain in a moist condition for several days, or without such treatment, can be neutralized with alkali carbonates or borates, but this is a difficult task. Extreme care is necessary not to carry the neutralization too far, because otherwise the grain will become brittle. Only by the greatest care is it possible to entirely avoid this mistake.

Otto Röhm, Darmstadt, Germany, has found that this bleeding of the leather easily can be prevented, if formate of iron alone, or together with inorganic iron salts, is used for the tanning process in either acid or basic solution. Leather produced in this way immediately can be treated with water without being first stored and without being neutralized, and does not lose its tanning. For example, 100 parts of depilated skins are treated with 150 parts of water, 3 parts of common salt and 2 parts of formic acid, and then with 30 parts 2/3 basic formate of iron, with gradual strengthening; or 100 parts of depilated skins are treated with 150 parts of water, 30 parts of common salt and 2 parts of hydrochloric acid and then with 15 parts of 2/3 basic chloride of iron and 15 parts of 2/3 basic formate of iron, with gradual strengthening.

Further, Röhm has found that the bleeding also is prevented if the moist leather taken out of the tanning liquor is treated with a solution of calcium salts of formic or acetic acid. In this case no loss of tanning principle occurs on washing the leather, and a previous neutralization is unnecessary. According to this process 100 parts of leather tanned with 2/3 basic solution of ferric chloride are agitated for half an hour in 200 parts of water and 8 parts of formate of calcium, whereafter it is washed with water, greased, dyed and trimmed. It has indeed been proposed to treat ferro leather, after it has been tanned, with solutions of neutral salts of alkalies, as sodium sulphate and sodium chloride. The salts of fatty acids, however, are much superior to such inorganic sodium salts.

Activating Animal and Vegetable Fibers

Johannes Korselt, of Zittau, Germany, has found that certain ferments, such as catalase, confer upon silk certain valuable properties, and that by treating other fibers, either animal or vegetable, such as wool, hairs, feathers, cotton, artificial silk and the like, with such ferments it is possible to render these fibers active. If wool, for instance, is treated with catalase, its strength and elasticity, as well as its power of absorbing coloring matter, is greatly increased. Wool which contains so-called dead hairs not well adapted to be colored, is rendered active upon being treated with suitable ferments such at catalases. The dead hairs take the color exactly like normal wool. At the same time the strength and elasticity are increased. If cotton or other fibers produced from a vegetable material, such as for instance artificial silk, are treated in a like manner, valuable properties are imparted to them and, quite especially, their power of absorbing coloring matter is greatly increased.

The process is applicable to fells, feathers, hairs, cotton, jute, hemp, linen, wool, artificial silk and the like and may be applied at any time, e. g., before spinning, before, during or after dyeing, during the finishing and so on. Korselt, U. S. Patent 1,426,298, treats the fibers, feathers or hairs to be rendered active either singly, for instance by burling, or in the lock, in the top or sliver, in the cord or, in the case of fells or textile fabric, in the piece, with ferments such as catalases or reductases. The selection and quantity of the ferments used varies according to the desired result; as a rule very small quantities, e. g., from 0.1 to 2 per cent. will suffice.

A like result cannot be obtained by the aid of exclusively zymotic ferments such as the diastase, or such ferments as are effective in flax-retting or in dyeing with natural indigo in the steeping-trough. It is of special advantage further to treat the fibers with such materials as favor the vitality (activity) of the ferments employed, such substances being for instance the kinases. If catalase is employed, creatinin is added as an activating medium. By the suitable selection of the ferments the fastness of the colors produced on the activated fibers is increased.

Between the usual methods of dyeing textile fibers with natural indigo, or the like, in the steeping trough, which contains certain ferments, and the process here outlined is the difference that in the latter only such ferments are used which do not contain any coloring components. In other words, the ferment is in the nature of an enzyme which will not ferment or decompose starch and albumin.

Zinc Dust

Zinc dust is generally obtained as a by-product when distilling zinc in retorts; but the density of the zinc vapor in this case being comparatively great and the temperature of the condenser being comparatively high, it is possible to obtain only a limited quantity of zinc dust. Moreover, zinc dust thus obtained is very coarse, part of it oxidized, and the metallic zinc contained therein is comparatively small in quantity.

Teisuke Kato, of Hyogoken, Japan, (U. S. Pat. No 1,425,661), has devised a process of manufacturing zinc dust which consists in converting metallic zinc or ores or other materials containing metallic zinc or zinc oxide, into zinc vapor by heating the material, together with a reducing agent, by fuel or electricity in a furnace or retort so constructed that it is not exposed to the air; diluting the zinc vapor with a non-oxidizing gas, and settling the very fine zinc dust by suddenly cooling the zinc vapor.

Chlorine as a Desulphurizing Agent in Ferrous Metallurgy

Most iron ores contain sulphur whose presence in iron or steel has ordinarily deleterious influence upon its properties. Its elimination or reduction is a constant problem in ferrous metallurgy. Great simplification of procedure in ore reduction awaits a commercially practicable method for the diminution or elimination of the sulphur, which also is introduced by the use of coke. William L. Estabrooke, of the College of the City of New York, and Daniel D. Jackson, of Columbia University, have found that chlorine and a variety of its compounds, as representative of the halogen group, have such virtue as desulphurizing agents as to warrant the hope that a commercial process based on such use may be a possibility of their U. S. Pat. No. 1,426,054.

According to the process, the iron or steel, or iron ore or coke is brought into contact with the halogen, or halogen compound which must liberate the halogen at the temperature of the iron mass undergoing treatment. Owing to its availability, cheapness and facility of use, chlorine is most practicable. This may be introduced into the blast furnace, as a gas, along with the air blast, or into a receptacle containing the molten metal, whereupon it reacts with the sulphur forming chiefly sulphur chloride which is volatile at the temperature prevailing. If used as a pulverized solid, as calcium hypochlorite, the lime combines with the phosphorus and enters the slag. Similar treatment applied to coke eliminates the sulphur therein before its introduction, from this source, into the blast furnace. Phosgene ($COCl_2$) may be used to advantage in the blast furnace, the CO acting as a reducing agent on the ore.

The following results of tests of the application of chlorine to molten gray cast iron are given:

	Chlorine Treatment Before		After
Sulphur Content	.66%	5 min.	.28%
		10 min.	.03%

A Partial Substitute for Bakelite

In preparing or working bakelite, especially in the intermediate stage, for use as a material of the final desired product, it has a tendency to harden or decrease in plasticity in a relatively short time, thus impairing its efficiency and desirability as a material for molding or for mixture with other ingredients of a final composition wherein the bakelite functions as a binder for a more or less inert filling material. The desirable dielectric and mechanical properties of bakelite not only well adapt it for use as an electrical insulating material, but these qualities are imparted to the article or composition in which it is present, regardless of whether the product is a molded article or is used for impregnating or coating articles to be insulated. James P. A. McCoy, of the Allis-Chalmers Mfg. Co., Milwaukee, Wis., has devised a composition for use in association with bakelite as the binder for the ingredients of an insulating composition which may be either a molded article or a less plastic and pliable substance useful as a coating. This material is the more or less polymerized products of indene, cumarone and their isomers. Indene and cumarone are readily polymerized to a degree by means of sulphuric acid which, when added to a solution of either or both of these substances, forms a partly polymerized resinous material. In the case of coal tar distillate the substance is a mixture of paraindene and paracumarone. These partly polymerized resins are readily soluble in many of the usual organic solvents, including coal tar oils, such as anthracene oil.

Paraindene and paracumarone, either separately or mixed in any proportions, are, in themselves, excellent binders for the manufacture of electrical insulating material and are adapted for use in both hot and cold molding processes. A resin of the character described is considerably cheaper than bakelite, although not of as high insulating efficiency, thus causing the dielectric strength of the product to be somewhat below what it might be if bakelite alone, in the required amount, were used as the binder. Hence the proportions of bakelite and resin are determined by the required insulating value of the product. The increased facility with which the bakelite-resin mixture may be handled, by virtue of the latter ingredient, more than compensates for any decrease in insulating quality.

Mr. McCoy has found (U. S. Pat. No. 1,425,784), that a desirable molded product may be obtained with a composition of 90 per cent. ground asbestos, 5 per cent. of a mixture of bakelite and partially polymerized paraindene and paracumarone, and 5 per cent. of raw China wood (tung) oil. The ingredients should be mixed into a pulp or sludge with a suitable solvent, such as benzol, and pre-formed while cold in a mold of the desired shape but of somewhat larger size. The material may be heated in the pre-forming mold at a relatively low temperature to drive off the solvent, after which the pre-formed articles are given a final molding and heat treatment in hot molds to effect the substantially complete polymerization of the resinous binder and the vegetable oil.

The China wood oil in addition to replacing a portion of the solvent required, has the characteristic of increasing in volume upon polymerization, the latter being ordinarily completed during the final baking of the molded article; and the oil, if present in the proper quantity, may exactly compensate for the shrinkage due to the expulsion of the binder solvent from the material. The filling material may be chosen in accordance with the desired physical qualities of the final product.

Personal Items

George T. Bristol of the cellulose products department of E. I. du Pont de Nemours & Co. has been appointed manager of the company's Fabrikoid plant at Newburgh, N. Y.

* * *

Dr. J. H. Rogers has resigned from the research staff, Experimental Station, E. I. du Pont de Nemours & Co., to enter the research laboratory, Standard Oil Co. of Indiana, Whiting, Ind.

* * *

C. C. Concannon, Harvard 1911, formerly with Takamine, Inc., 120 Broadway, New York, has been appointed assistant chief, chemical division, Bureau of Foriegn and Domestic Commerce.

* * *

Dr. Frederick W. Atack, formerly chief chemist and director of research, British Alizarine Company, Ltd., Manchester, England, has been appointed a member of the board, Southern Dyestuffs Company, 505 Fifth Avenue, New York.

* * *

Dr. George B. Waterhouse, for the past 16 years with the Lackawanna Steel Co., Buffalo, N. Y., and for three years prior thereto, associated with the late Dr. Henry M. Howe at Columbia University, has been appointed head of the department of Metallurgy at the Massachusettes Institute of Technology and will assume his new duties at the opening of the fall term.

* * *

Charles E. Pellew, '84 School of Mines, Columbia University, and long a professor of chemistry at the College of Physicians and Surgeons and now at Columbia University, enjoys the unique distinction as the third American in recent years to inherit an English peerage which, on the death on August 17 of the late incumbent, descended to Prof. Pellew's father, aged '94, resident at Washington, D. C. Owing to his advanced years it is reported that he will pass on to his only son, who already has announced his willingness to accept it, the duties and obligations of the peerage of Exmouth.

SITUATION WANTED

CHEMIST—Recent graduate from Columbia University, having his B.A. and M.A., desires position with a firm where there is a chance for advancement. Salary to start immaterial. Box No. 802, care of Chemical Age.

POSITION WANTED

A young man, age 25, B. S. in chemistry, desires a position with a growing concern engaged in the production of vegetable oils. Has had nearly four years' experience in the laboratory of one of the largest cottonseed oil refiners in the U. S. Is very anxious to get out into plant work and to make use of his chemical training and experience. Is willing to leave the United States for a good offer. At present employed in a very good position. Address Box 801, Chemical Age.

CHEMICAL ENGINEER, age 42, European education, at present employed in Europe in large chemical manufacturing establishment; possesses a wide experience in the manufacture of chemicals, especially of tartaric acid and its technical derivatives; seeks United States connection in similar capacity. Address Tartar, care of Chemical Age.

CHEMICAL ENGINEER, leaving for Central Europe the latter part of September for a few months, will be pleased to represent you in any capacity pertaining to the Chemical Industry. Address, John Endler, 1014 West 87th Street, Chicago, Ill.

CHEMICAL
AGE

A CONSOLIDATION of THE CHEMICAL ENGINEER and CHEMICAL AGE

LLOYD LAMBORN, *Editor*

VOLUME 30 NEW YORK, OCTOBER, 1922 NUMBER 10

The Chemical Age and the Potentialities of the South in the Industrial Applications of Chemistry

By Joseph E. Ransdell
United States Senator from Louisiana

WE live in the Chemical Age, and the great science of chemistry is growing more important every day. Chemistry made marvelous advance during the last century, especially the latter half, and placed all the arts and sciences under heavy tribute, none more so than medicine, war, the mineral world and soil fertilization. Progress certainly, but in reality only a beginning, has been made in the study and application of chemistry to the myriad questions that confront the human race. Many of the unknown things of nature have given up their secrets in the laboratories of chemists, but only the surface of the hidden world has been scratched; secrets innumerable are yet to be unveiled.

JOSEPH E. RANSDELL
United States Senator from Louisiana

Development of Chemistry in America

Chemical industry in the United States should be developed along the broadest and most comprehensive lines for several reasons which I will enumerate briefly.

I. Chemistry is essential to the successful prosecution of practically all the arts and sciences. An indefinite variety of chemical products enter into the manufacture of the essentials of food, clothing and shelter. In fact, there is no industry of modern civilization which does not require the constant aid of chemistry for its successful operation. Therefore, we cannot afford to be dependent upon the chemists of any other country but should develop every branch of the science and art in America.

II. The wonderful growth in chemical inventions and discoveries during the past century warrants us in believing that innumerable things still are hidden which will respond to intelligent, persistent effort on the part of chemists. Many of the diseases of man have been greatly ameliorated by chemical inventions and discoveries of recent years, such as aspirin, novocaine, salvarsan, etc. Why can we not expect the discovery of remedies that will give relief, and possibly effect cures of such diseases as leprosy, cancer, pneumonia, tuberculosis, and others which afflict mankind so terribly?

Our American chemists are quite as intelligent as the Germans; and if we encourage and help them during the next 50 years as effectively as Germany did her chemists during the last 50, we can expect equally good or better results, not only in the relief of human suffering but along industrial lines, and those of national defense.

III. It is unfortunate that the nations of the world cannot remain at peace and ignore all preparations for war, but so long as this greatly desired end seems still in the distant future it behooves wise men to prepare for possible conflict. Most thinkers agree that the next war will be decided by the chemical preparedness and foresight of the contestants, and that it will be a chemical war. Indeed, during the last two years particularly of the World War, chemistry played a most important part, and there is every reason to believe its part in the next war will be infinitely more important.

There is the closest alliance between the chemistry of peace and the chemistry of war. Chemical industries of commerce can be quickly and cheaply converted into producers of war chemicals. Many of the commodities of one are available for the other. America must be prepared thoroughly for strife if it should ever come again, and in order to be so prepared she must develop her chemical industries along such lines that our people will become a nation of chemists familiar with the science in every way, and of people understanding its applications in their daily lives.

Chemistry in Schedule I of the Present Tariff Bill

When the chemical schedule of the present tariff bill was under consideration I worked actively for a high protective duty on all chemical products, as I believed it to be essential to the proper development and maintenance of the industry in our country.

Schedule I of this tariff bill, which relates to chemicals, oils and paints, is characterized by my colleague, Senator McCumber, as providing for the first time in our history adequate protection for our domestic chemical industry. Heretofore our tariff protected the inorganic chemical industry, but allowed the foreigner to dominate our markets with their organic and synthetic products. These covered practically our entire dye and synthetic drug consumption. The war demonstrated that a country without this industry is terribly handicapped, and to survive must establish a domestic chemical industry.

In following out this policy, this schedule has been much elaborated. Many chemicals and chemical products have been here specified for the first time, because of their greater importance in modern civilization. Certain chemical articles also have been transferred from the free list to this schedule, such articles as ambergris, musk, paris green, salt, etc. The rates of duty upon the several paragraphs have been very carefully adjusted. In many cases, where conditions permitted, the rates of duty have not been increased over the previous rates of duty. In others the rates have been only slightly increased, while in others considerably higher rates of duty have been imposed.

The reason for these higher rates is that our foreign competitors are not only able to manufacture these particular articles or products at a small fraction of the domestic cost of manufacture, but are so organized, and make use of such methods that without these higher rates of duty our domestic industry could not survive. This was fully demonstrated prior to the war by these same manufacturers who succeeded in dominating not only the American market, but the entire chemical industry of the world.

Chemical Resources and Progress of the South

With these general principles stated, let us now consider some of the chemical possibilities of the South. Our historical chemical industry is that of turpentine and rosin production in which for three generations the South has led the world because of its pine forests. Because of this advantage the South not only supplied our domestic requirements of pine products, but exported a volume greater than that supplied from all other sources. The long-leaf and slash pines provide annually turpentine and rosin to the value of about $40,000,000. The depletion and wasteful use of this resource has compelled a refinement of utilization to meet the increasing demand and to overcome the decreasing supply, whereby pulp for paper manufacture and a series of pine chemicals are now commercially produced.

The pine tree is the basis of the South's timber industry, whose by-products, saw dust and stumps, have been converted into the same products obtained from the timber, in a way to bring to the man in the street and to the man in the pine woods an appreciation of the significance of chemistry in the progress of a vast domain. The utilization of the pine wood, after the extraction of its rosin content, in the manufacture of paper, has given to the South an industry of tremendous importance in view of the rapidly diminishing sources elsewhere in the country of wood used for paper. While the bulk of our standing timber now is in the far Northwest, the chief part of the annual growth is in the South, where also not only are available in great abundance and accessibility the accessory raw materials of paper manufacture, but a rapidly growing market for the various grades of paper.

The educational influence of chemistry has been demonstrated in an even more intimate way in the utilization of the cottonseed whereby applied chemistry has brought to the cotton farmer a source of wealth incalculable, aside from its material accretion, in its significance to southern productivity. Not only has the seed yielded under the research of the chemist a long line of edible and industrial products, but the fibre of the seed, in addition to supporting a great textile industry attracted to the source of its raw material, has become the essential raw material of the motion picture film, artificial leather, lacquers, and the varied products of the plastics industries.

The plant food requirements of southern soils are met conveniently by deposits of phosphate and the manufacture of sulphuric acid. At Ducktown, Tenn., is the largest sulphuric acid plant in the world, created from the utilization of a metallurgical by-product. Natural deposits of sulphur supplement the by-product sulphur in such abundance and obtained for use with such genius as to constitute one of the wonders of chemical engineering. Agricultural chemistry has shown the superior economy of feeding nitrogen-bearing cotton-oil cake directly to stock rather than indirectly to the growing plant. Potash is potential in the blast-furnace dust of our steel plants and cement kilns.

In addition to these products, I need only mention the South's practical monopoly of bauxite for the manufacture of aluminum, its tremendous stores of petroleum, gas, silica, salt, iron, coal, limestone, barytes, quartz, zinc, manganese, lead, nickel, lignite, etc., some of which are being partially utilized and others are awaiting development. The South possesses over 70 per cent of the coking coal of the country, and at least one-half of its iron ore. As a son of the South, I will say that there is no part of our common country whose people should be more appreciative of the work of the chemist than those "Down in Dixie."

The South is blessed with water power, estimated at 5,000,000 potential horse-power, of which only a small part is utilized at present, but which will be harnessed in increasing volume as industrial growth becomes more intensive. We have in the war-time development at Muscle Shoals an unappreciated national asset whose utilization should not be delayed.

Chemical Resources and Progress of Louisiana

In this article I have laid down principles applicable nationally to chemical industry; I have paid tribute to the chemical resources of the South; let us now consider the chemical resources of Louisiana and the enterprise of our people in their development.

Nature has been kind to Louisiana, for in addition to a soil of surpassing fertility, we have in close proximity salt, sulphur, limestone, clay, petroleum, natural gas and lignite, accessible by navigable streams and railroads. The two basic products, salt and sulphur, exist here in almost chemical purity. Their position as the fundamental inorganic chemical raw materials I need not emphasize, nor dwell long upon the potentialities of Louisiana as a chemical manufacturing state. Possession of the greatest natural gas field in the world and our rank as the fourth state in petroleum production give us an advantage in power and fuel resources comparable to Niagara. The utilization of lignite is delayed by the abundance of more efficient fuels, although as a clarifying agent in our sugar industry it represents a fine application of chemical knowledge to a low-grade raw material. The development of our mineral resources is only in its infancy.

In addition to the natural resources of Louisiana, she is situated in a most advantageous geographical position because of the Mississippi River, and her proximity to the Tropics, South America and the Panama Canal. Products, mineral, vegetable and animal, from the west coast of the United States, South America, Central America and the West Indies find their natural gateway into the Union through the great portal of the Mississippi. Deep-draft ocean vessels can carry their cargoes 250 miles from the Gulf to cities and factories on either bank of the mighty river and return with commerce for any part of the world. The Mississippi and the splendid rivers which connect with it furnish excellent transportation for the raw materials and finished products of chemical industries on their banks, and efficient railroads supplement them with their lines extending in every direction throughout the state and Nation.

Southern labor is comparatively cheap, plentiful and, above all, is not Bolshevik in character. The workingman requires fewer clothes and less housing than in the North, and his food is to some extent grown at home. These, together with the cheap lumber and building materials, reflect very appreciably in the final cost of production to the manufacturer.

The South will welcome the scientist or chemical engineer in his efforts along any one or more of the numerous lines of his great profession, and he will make a mistake if he does not thoroughly investigate the wonderful industrial resources which Nature has provided in that favored region.

The land of Dixie offers innumerable opportunities to men of brains and energy, and no part thereof has advantages superior to those of Louisiana. I unhesitatingly invite any chemist or chemical engineer who is seeking to better his condition, or any capitalist looking for good investment, to examine carefully the Louisiana field before locating elsewhere. I can assure him a hospitable welcome and fine prospects in many lines.

Chemical Equipment Association

THE basic principle of modern industry is service predicated on enlightened selfishness, which finds its fullest expression in co-operation among those engaged in the same field or line of business. A single individual or concern is powerless alone to correct conditions inimical to the welfare of all of the group, or to establish practices from which all of the group may derive advantage, or to promote projects of general utility to all with whom the group or trade comes in contact. What the individual alone can gather, with the incidental waste of duplication, will not carry him through; he must have all of it. To get all of it he must cooperate with others of the same desire whereby the members of the group or trade share not solely according to the measure of this contribution to the common good, but increasingly so by virtue of the benefits of united action.

This is the corner stone of the trade association whose constructive influence in industrial progress is recognized by Government which sees in it not only the one effective way to deal with specialized industry but the only way whereby industry may govern itself and attain progressively that ideal of material welfare which is the ever greater abundance of cheaper goods.

The trade association has come into existence in the natural evolution of business and represents the seasoned judgment of the factors in any given field that only by organized consideration of its common problems can they find that solution which works for stable growth of the industry. Only by community of action that involves no sacrifice of individual initiative or repression of equality of opportunity can be inculcated those principles of industrial progress that every alert manufacturer recognizes as essential if industry is to be conducted on a basis of service that connotes a reasonable margin to those who provide it. The trade association simply is an instrument to aid in the general introduction into any given field of those principles and practices which are indispensable if the program of elimination of waste in industry is to have practical realization.

The Manufacturing Chemists' Association of the United States has completed a half century of existence and is one of the oldest trade associations in the country. It embraces in its membership those producers in chemical industry which are concerned with inorganic products and ever has been active in protecting the interests of its members in legislation, in stabilizing trade conditions in its field and promoting harmony in the production and merchandising of its products without which its essential service as a basic industry would be impossible.

The Synthetic Organic Chemical Manufacturers' Association is the present form of organization among producers of synthetic organic chemicals, which was called into existence to protect and promote the key industries of our economic system which the embargo of war permitted to take root in the United States. The protection accorded the enterprise of its members in our present tariff law is the result of its activity, without which its continued existence would be impossible. Its virility in service to its members simply reflects the seriousness of alien onslaughts and the increasing popular appreciation of its essential character to national independence, which attitude it has been instrumental in creating.

The Scientific Instrument Manufacturers' Association embraces those who supply chemical and allied industries with its instruments of precision and general scientific equipment. Our dependence upon alien sources of supply was brought home by the deprivation incident to hostilities and compelled a coalescence of interests by those who sought to supply the deficiency by the creation of domestic industries in this important field.

It required the stupendous demands of modern warfare not only to demonstrate the dependence of chemical industry upon the varied industries that supply it with production equipment and accessories, but to indicate to the members of this group their wide community of interest and the importance of cultivating it to the end that its service to chemical production may attain its fullest efficiency. Conspicuous in this aspect of solidarity in chemical enterprise is the realization that the tool-maker is an indispensable factor in chemical progress, for his ingenuity is its corner stone.

As reported in CHEMICAL AGE, May, 1922, representatives of prominent concerns engaged in chemical plant equipment and accessories manufacture met at the Chemists' Club, New York, May 10, 1922, and organized the Chemical Equipment Association and adopted the Constitution and By-Laws, in which are set forth the objects of this trade association, to wit:

1. Encourage high standards in the industry.
2. Promote a better knowledge of conditions controlling the industry's development.
3. Take steps to bring about definite understanding as to professional services rendered to purchasers in connection with the sale of equipment.
4. Investigate conditions surrounding the resale of equipment originally produced for specific purposes.
5. Disseminate information as to methods of arriving at correct costs.
6. Standardize trade phrases.
7. Collect and disseminate information as to raw material, design and construction.
8. Take suitable and timely notice of, and action upon matters legislation, both national and state, which affect the members of this Association.
9. Collect and disseminate market statistics, both domestic and foreign.
10. Collect and disseminate information as to labor conditions and relations.
11. Enter into such other legitimate trade association activities as may be deemed in the interest and welfare of the industry.

It is distinctly understood that this Association will not undertake any activity which may restrain trade, limit production or competition, regulate prices, or otherwise be in violation of the law.

At a meeting of the Chemists' Club, Sept. 12, the Constitution was modified to provide for regional vice-presidents and the dissociation of the office of secretary-treasurer whereby the secretary would be employed directly by the board of directors and would devote his entire time to the work of the Association. The following administrative staff was elected:

President: Pearce D. Schenck, president, The Durion Co., Inc., Dayton, Ohio.

Vice-Presidents: Walter E. Lummus, president, Walter E. Lummus Co., Boston, Mass.; Adolph Coors, Jr., president, Coors Porcelain Co., Golden, Colo.; George J. Lehman, vice-president and general manager, Bethlehem Foundry & Machine Co., Bethlehem, Pa.

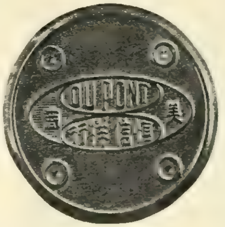
Treasurer: P. C. Kingsbury, chief engineer, General Ceramics Co., 50 Church St., New York.

Directors: H. K. Spicer, The Dorr Co.; J. I. Lyle, Carrier Engineering Corp.; P. S. Barnes, Pfaudler Co.; E. C. Alford, T. Shriver & Co.; T. C. Oliver, Chemical Construction Co.; H. H. Alpert, E. B. Badger & Sons Co.

The Chemical Equipment Association in the six months of its existence already has drawn to it many prominent equipment supply people who recognize the possibilities of service not only to its own field but to the general field of chemical manufacture which constitute the industry's market place. The concerns which should belong to this Association and contribute their share to the promotion of its laudable purposes are so numerous that the Association can not realize its program unless it has the co-operation of their membership. Active steps are now being taken to enroll new members. If the effort meets with as successful results as obtained during the past six months, the first year of the Chemical Equipment Association abundantly will have justified its organization and put it in a position to inaugurate its plans for the improvement of the industry.

A Dyestuffs Trade-Mark for China

The dyestuffs department of the E. I. du Pont De Nemours & Co. has hit upon an interesting way to gratify the Chinese love of "cumshaw," i.e., something for nothing, and at the same time provide a secure, rust-proof fastening for their indigo shipments to Chinese markets. The indigo is shipped in one picul kegs, 133 1/3 lbs., being calculated a suitable burden for one Chinese back. A copper seal is fastened over the bung in the filling hole by means of screws, which are then soldered. The seal prevents tampering with or adulteration of the contents and, being of copper, is not affected by moisture. At the same time it serves as a very acceptable prize for the Chinese in the dye houses where the indigo is used.



The characters in the lower oval, reading from right to left, as translated in the *Bulletin of the Copper & Brass Research Association,* are "Hung Hsin Yang Hong," meaning "constantly reliable foreign firm." The characters on either side of the two small ovals are "Shang" and "Mei," which means "American corporation."

The bulk of the dyes imported into China consists of artificial indigo, according to Julean Arnold, U. S. Commercial Attaché at Shanghi, of which probably 90 per cent. is distributed among the Chinese consumers in the form of artificial indigo paste containing 20 per cent. indigotin. Six months ago the average selling price of artificial indigo paste containing not over 20 per cent. indigotin was about 75 taels, or $56 (gold), per picul of 133 1/3 pounds. To-day the same article is selling at about 40 taels, or $30 (gold), per picul. This latter price is approximately the same as the pre-war values. The reduction is due, in the main, to the heavy importations from German manufacturers whose production costs, owing to the German exchange, are much lower than those in America.

The annual imports of artificial indigo into China are about 11,000,000 taels in value, or $8,580,000 (gold). When the selling price rises much above 40 taels per picul (which at the current rate of exchange is equivalent to $23 gold per 100 pounds) the Chinese take to the greater use of natural indigo, which is produced in China and also imported from India. It appears that Chinese trade cannot afford to use natural indigo when the artificial product can be purchased in the proximity of 40 taels per picul.

The selling of indigo dyes in China can be done successfully only through an organization thoroughly conversant with the details of this business. At present the Swiss, French, and American interests able to compete with the German product are manufacturers handling their own products through their own organizations in the field. The bulk of the trade will go to those manufacturers who are able to supply the material at the lowest price and in a form acceptable to the consumer in the interior of the country. It is estimated that 60 per cent of the world's production of artificial indigo is consumed in China.

Production of Glycerin by Fermentation

MUCH study has been given to the conditions necessary to the maximum production of glycerin in the alcoholic fermentation of sugar, especially in Germany where during the war considerable glycerin was obtained from this source.

By their process* is practicable the production of glycerin in larger quantities than heretofore, in addition to acetaldehyde and alcohol, by a yeast fermentation of a solution containing fermentable sugar with such proportions of normal sulphite and bisulphite of an alkali metal as will produce a mixture of mash and salts which is approximately neutral to litmus and which does not inhibit fermentation.

It has been thought necessary to use large additions of alkaline salts to the mash in order to obtain good yields of glycerin, and that within certain limits the greater the amount of alkaline salt added, the higher the yield, but Allen T. Cocking and Cecil H. Lilly have found that alkaline additions are unnecessary and have substantial disadvantages.

The mixed sulphites in aqueous solution are added in successive small proportions, until an amount has combined with the acetaldehyde corresponding to the yield of glycerin required, having regard to the other by-products which may be desired, or until the amount of sulphites practically required for the production of the corresponding theoretical yield of glycerin is reached. The theoretical quantity of sulphite, calculated as Na_2SO_3, corresponds to 70 per cent of the weight of the fermentable sugar, the theoretical yield of glycerin then amounting to 50 per cent of the fermentable sugar, but the amount practically required may amount to 80 per cent. The amount of normal sulphite added must eventually be sufficient to combine with the amount of aldehyde to be formed during the fermentation process.

The production of glycerin by fermentation in the presence of normal sulphites depends upon the fixation of an intermediate product of alcohol fermentation, viz, acetaldehyde, and upon the affinity of acetaldehyde for bisulphites. Bisulphites are relatively strong antiseptics and cannot be used alone in large quantities, so it has been believed necessary to allow the bisulphite to be produced by the reaction and taken up at once by the acetaldehyde. It has been found, however, that they may be used in conjunction with normal sulphites, producing a mixture which in solution is relatively non-antiseptic and neutral in reaction to litmus.

The use of the mixed sulphites has substantial advantages, e.g., the presence of the bisulphite anticipates the eventual splitting up of the normal sulphites in fermenting liquors, resulting in the fixation of the acetaldehyde at an earlier stage and consequently the saving of a portion of the sugar which with normal sulphites alone would pass completely through the various stages of fermentation to alcohol before sufficient bisulphite could be formed for fixing the intermediate product, acetaldehyde. Thus with normal sodium sulphite alone, the following reaction would take place:

$$Na_2SO_3 + CO_2 + H_2O = NaHSO_3 + NaHCO_3;$$

the reaction with the salts mixed in equal proportions being:

$$NaHSO_3 + Na_2SO_3 + CO_2 + H_2O = 2NaHSO_3 + NaHCO_3$$

Again in such fermentations the alkalinity resulting from the splitting up of the sodium sulphite can be reduced to a minimum, or may be entirely eliminated by adding bisulphite or increasing the proportion of bisulphite to normal sulphite in the subsequent additions, so as to neutralize the bicarbonate formed, thus, the reaction when using normal sulphite alone is as follows:

$$CO_2 + H_2O + \underbrace{2Na_2SO_3}_{252} = 2NaHSO_3 + \underbrace{2NaHCO_3}_{168};$$

the reaction with a mixture of the salts in molecular proportions being

$$CO_2 + H_2O + \underbrace{NaHSO_3 + Na_2SO_3}_{230} = 2NaHSO_3 + \underbrace{NaHCO_3}_{84}.$$

showing that with the normal sulphite, 252 parts will produce 168 parts of bicarbonate, whereas with the mixed salts, 230 parts of the mixed sulphites produces only 84 parts of bicarbonate.

Messrs. Cocking and Lilly find that most yeasts can be used without special precautions being taken to acclimatize them to the special condition; also that for the same glycerin yields, the fermentation period, when using the mixed sulphites, is considerably less than when normal sulphite alone is employed.

General Procedure

In carrying out the process, 15 gallons of an aqueous solution of molasses or sugar, containing 10.5 per cent of total fermentable sugars and the yeast culture, are added an aqueous solution containing 5 lbs. of a mixture of Na_2SO_3 and $NaHSO_3$ in equal proportions to produce a solution having the reaction neutral to litmus. After 18 hours of fermentation a further 2 lbs. of the mixed sulphites previously dissolved in a portion of the fermenting liquor are added, this operation being repeated with 1 lb. of the mixed salts added at 24 hours, and a further 1 lb. at 26 hours. In this case 86 per cent of the sugars present are consumed in 120 hours from the commencement of the operation, and the yield of glycerin calculated on the sugar consumed amounts to about 35½ per cent, the average temperature throughout being 36° C.

In the above example the commercial sulphite mixture added contains the equivalent of 90 per cent as Na_2SO_3 so that in all 9 lbs. of the mixed commercial sulphites containing actually 8.1 lbs. of mixed sulphites were added. At the end of the above period, the solution contained 0.9 per cent of uncombined Na_2SO_3, and 1.5 per cent of unfermented sugar, so that 6.8 lbs. of Na_2SO_3 had combined in the reaction, whilst 13.7 lbs. of sugar had been fermented. The calculated yield of glycerin on the sulphite combined is equivalent to 4.89 lbs. of glycerin on 13.7 lbs. of sugar consumed, or 35.6 per cent. Actual analysis gave a figure of 35.5 per cent. The ratio of sugar to sulphite added was 100:50, whilst the ratio of sugar consumed to sulphite combined was 100:49.6. The theoretical proportions for the maximum theoretical yield of glycerin, i.e. 50 per cent on the sugar consumed, are 100:70. By this method it is unnecessary to add the sulphite in quantities exceeding to any great extent those theoretically required; nevertheless it is desirable to add up to about 10 per cent in excess of the theoretical requirements, and the yields of glycerin and other products can be regulated as desired.

It has been found better to dissolve the mixed salts to be added, in water instead of in a portion of the fermenting liquor as the time required for completion of the fermentation is thus reduced and injury to the cultures is avoided. By increasing the total quantity of sulphites added, and continuing the fermentation, the yield of glycerin and actaldehyde can be increased up to approximately 50 per cent of glycerin expressed on the sugar consumed, with the production of relatively less alcohol. The avoidance of additions of sulphites in large excess has the advantage that the working up of the fermenting liquors is considerably facilitated.

---

*U. S. Pat. No. 1,425,838 issued August 15, 1922.

By this process a freedom of choice is conferred on the user as regards the relative proportions of the principal products obtained, i.e., glycerin, acetaldehyde and alcohol. In some circumstances, e.g., it will be desirable to produce less glycerin and acetaldehyde and more alcohol. To illustrate the flexibility of the process in this respect, three examples of procedure are given: (1) Where the maximum glycerin yield is desired; (2) Where a smaller yield of glycerin and a higher yield of alcohol is desired; (3) Where a still smaller yield of glycerin and a still higher yield of alcohol is desired.

I. Maximum Glycerin Yield Desired

To 311 gallons of a sterilized solution of crude cane sugar equivalent to 788 lbs. of glucose (23.8 per cent on solution) 40 lbs. of pressed yeast are added. At intervals extending over a period of five days when the fermentation was most vigorous was added an aqueous solution of a mixture of sodium sulphite (95 per cent Na_2SO_3) and sodium bisulphite (95 per cent $NaHSO_3$) in equal parts by weight, which solution was neutral in reaction to litmus. At first 40-lb. quantities of the mixed salts in 16 gallons of water were added each time, but later 30-lb. quantities in the same volume of water were added. In all, and extending over the period mentioned above, 176 gallons of water containing the mixed salts, equivalent to 545 lbs. of Na_2SO_3, were added, and the fermentation was allowed to complete itself for a further four days at a temperature of 35-37° C.

Therefore 788 lbs. of sugar in 487 gallons of liquid is equivalent to an initial sugar concentration of 16.1 per cent. After nine days 95 per cent of the original sugar had been consumed while sulphite equivalent to 39 lbs. of Na_2SO_3 remained in the solution uncombined. Therefore 749 lbs. of sugar during fermentation had fixed a quantity of salts equivalent to 506 lbs. of Na_2SO_3. This quantity of Na_2SO_3 is equivalent to a production of 364 lbs. of glycerin or 48.6 per cent of the weight of sugar consumed. Actually 336 lbs. of glycerin were found by analysis, or 45 per cent calculated on the weight of sugar consumed. The acetaldehyde produced in this case is equivalent to 23 per cent of the sugar consumed, viz., 172.2 lbs. while the alcohol amounts only to 5 per cent of the sugar consumed, viz, 37.4 lbs.

II. Smaller Yield of Glycerin and Higher Yield of Alcohol Desired

To 412 gallons of a sterilized solution of crude cane sugar equivalent to 830 lbs. of glucose (20.1 per cent on solution), 40 lbs. of pressed yeast are added. At intervals extending over a period of three days, when the fermentation was most vigorous was added a solution in water of a mixture of sodium sulphite (95 per cent) and sodium bisulphite (95 per cent) in equal parts by weight, which solution was neutral in reaction to litmus. At first 66 lbs. of the mixed salts in 24 gallons of water were added each time, but later the [illegible] reduced to 33 lbs. of mixed salts in the same volume of water per addition.

In all, and extending over the period mentioned were 232 gallons of water containing the mixed salts, equivalent to 511 lbs. of Na_2SO_3 were added and the fermentation allowed to complete itself for a further three days at a temperature of 35-37° C. Therefore 830 lbs. of sugar in 644 gallons of liquid is equivalent to an initial sugar concentration of 12.8 per cent.

After a period of six days from the commencement of the fermentation 98.4 per cent of the sugar had been consumed, while salts equivalent to 25 lbs. of Na_2SO_3 remained uncombined; therefore 816.7 lbs. of sugar had fixed a quantity of salts equivalent to 486 lbs. of Na_2SO_3. This quantity of Na_2SO_3 is equivalent to a production of 349.9 lbs. of glycerin of 41.6 per cent on the sugar consumed. Actually 351 lbs. of glycerin were found by analysis or 43 per cent calculated on the sugar consumed. The acetaldehyde produced in this case is equivalent to 21 per cent of the sugar consumed, or 171.5 lbs. while the alcohol amounts of 8 per cent or 65.3 lbs. of the sugar consumed.

III. Still Smaller Yield of Glycerin and Still Higher Yield of Alcohol Desired

To 145 gallons of a sterilized solution of crude cane sugar equivalent to 288 lbs. of glucose (19.8 per cent on solution) is added the culture remaining in the fermentation vat from a previous fermentation. At intervals extending over two days, when the fermentation was most vigorous, was added a solution in water of sodium sulphite (95 per cent Na_2SO_3) and sodium bisulphite (95 per cent $NaHSO_3$) in equal parts by weight, which solution was neutral in reaction to litmus twelve lb. quantities of the mixed salts in 8 gallons of water were added each time, the total additions amounting to 76 gallons of water containing mixed salts equivalent to 93 lbs. of Na_2SO_3.

At the end of four days at a temperature of 35° C. fermentation had ceased, 288 lbs. of sugar in 221 gallons of liquid is equivalent to an initial sugar concentration of 13 per cent. When fermentation has ceased 97 per cent of the sugar had been consumed, while no free sulphite remained in solution. Therefore 280 lbs. of sugar had fixed a quantity of salts equivalent to 93 lbs. of Na_2SO_3, equivalent to a production of 66.9 lbs. of glycerin or 23 per cent on the sugar consumed. Actually 70.8 lbs. of glycerin were found by analysis, or 24.6 per cent on the sugar consumed.

The acetaldehyde produced in this case is equivalent to 34.4 lbs. or 12.3 per cent while the alcohol amounts to 72.8 lbs. or 26 per cent on the sugar consumed. It will be seen that the higher yields of glycerin require a longer time of fermentation.

At a meeting of the Executive Board of the American Engineering Council at Boston, September 8th, the Federated Association of Engineering Societies appointed a committee to investigate thoroughly every phase of the Muscle Shoals proposition from the engineering standpoint, so that the public may have a concise, disinterested statement of facts. This entails a great piece of volunteer work on the part of the engineers appointed, the results of which will doubtless be of far reaching importance in clearing up the situation. Calvert Townley, past-president, American Institute of Electrical Engineers, is chairman of the Committee on Procedure. Other members are Dexter S. Kimball, president, American Society of Mechanical Engineers, J. Parke Channing, W. F. Rolfe, W. W. Varney and H. E. Howe.

* * *

Dr. A. R. Loetsch, department of chemistry, Iowa State University, has been appointed research chemist, Standard Oil Co of Indiana, Whiting, Ind.

Service of Department of Commerce to Chemical Industry

By C. R. De Long

Chief, Chemical Division, Bureau of Foreign and Domestic Commerce, Department of Commerce

WITHIN the Department of Commerce are maintained three Bureaus which may be designated as the three service bureaus of the Department. These include the Bureau of the Census, the Bureau of Standards and the Bureau of Foreign and Domestic Commerce. To bring the Department in closer contact with the chemical industry and to deal with the commercial problems of that industry, there was established, August first, a Chemical Division within the Bureau of Foreign and Domestic Commerce. This Division, in addition to handling the general inorganic and organic chemicals, also will devote its energies to the trade in drugs and medicinal preparations, essential oils, perfumery and toilet preparations, pigments, paints and varnishes, fertilizers and fertilizer materials, and explosives and pyrotechnics.*

C. R. DE LONG
Chief, Chemical Division Bureau of Foreign and Domestic Commerce.

Means of Collecting Information

Of first importance is a consideration of the means at the disposal of the Bureau for the collection of information relating to foreign markets and industries, which will be of service to American chemical industry. The Department maintains 28 permanent offices in the important commercial centers of foreign countries. These offices are in charge of business men and economists acquainted with the commercial conditions of each particular country. In addition, the Department enjoys the cooperation of more than 500 consular officers of the State Department. It is evident that these outposts of the Government form a vast network of lines of communication as regards commercial conditions in foreign countries. These representatives are constantly forwarding to the Department at Washington inquiries for American goods and information as to competitive conditions confronting traders in the different countries of the world.

These representatives are in a position to advise American firms and manufacturers as to agencies qualified to handle their products, as to the customs duties in force in the various countries and as to other commercial regulations governing the sale of products in a particular country. This information as to the world's markets, as received, is centralized in the various commodity and regional divisions of the Bureau of Foreign and Domestic Commerce. Here it is studied carefully and abstracted before being distributed to American industries. Through these sources the Chemical Division will be able to assemble in Washington accurate and detailed information as to the world's production of and requirements for chemical products.

Distribution of Information

The chief means by which this information is disseminated to interested firms is by publication in *Commerce Reports,* a weekly publication of the Department of Commerce. In this publication will be found a list of opportunities for the sale of American goods in foreign countries. It also contains a variety of articles on world economic conditions, and information as to markets for specific commodities in particular countries. An important feature is a weekly cable service from the Bureau field agents, setting forth the latest business developments in all parts of the world.

For the intelligent exportation of products it is necessary to keep in constant touch with changing conditions in the various markets of the world. For example, one ordinarily would not consider Germany as a market for American caustic soda, yet information reaching the Department of Commerce recently shows that there is an apparent shortage of caustic soda in this market, and that the demand is being supplied by the United States. As a matter of fact, approximately one-half of the caustic soda being imported by Germany is originating in this country. It can, therefore, be seen that with rapidly changing market conditions it is necessary to keep in constant touch with the various markets if advantage is to be taken of these opportunities to sell American chemical products abroad.

Exporters' Index

In order that American firms interested in the exportation of chemical products may receive the benefit of confidential information on trade opportunities in foreign countries, the Department maintains a classified list of American exporters and manufacturers, which is known as the "Exporters' Index". It should be pointed out that only American-owned firms interested primarily in the promotion and sale of products of domestic manufacture are eligible for listing on this "Index". A firm once listed on this "Index" is entitled to receive without charge confidential information on trade opportunities, such as financial references, reputation and standing of the firm making the inquiry, and other information helpful in the marketing of a particular commodity in a foreign country.

---

*From an address at the Eighth National Exposition of Chemical Industries, Grand Central Palace, New York City, September 12, 1922.

Such firms also are entitled to receive, whenever requested, trade lists of firms capable of handling their products in foreign countries. In order to supply accurate lists of such firms the Department is maintaining a World Trade Directory of foreign business concerns. This is a card index of foreign firms and is being constantly revised and expanded as information is received in the Department. These lists indicate the relative importance of the different merchants, the commodities which they are prepared to handle, and the nationality of the firm. This latter information, in negotiating agencies for American products in foreign markets, is particularly important as it would be unwise for an American firm to make connections with an agency of foreign nationality, which is more likely to be interested in developing the trade of a competing nation, rather than commerce in American products.

Because a firm is listed in the "Exporters' Index" it does not necessarily follow that all trade inquiries will be brought solely to that firm's attention. The usual distribution of these trade opportunities is by publication in *Commerce Reports*. Any firm interested in the exportation of chemical products should, therefore, become a subscriber to *Commerce Reports* and also should make application for listing in the "Exporters' Index". The aid that will result from these services of the Department is readily apparent to those interested in foreign trade.

Further to facilitate contact between the Washington office of the Bureau and business men, the Bureau maintains district offices in New York, Boston, Chicago, St. Louis, San Francisco, New Orleans, and Seattle. These offices, in many instances, are in a position to supply immediately up-to-date information from their files. In addition, the Bureau has extensive cooperative arrangements with the foreign trade departments of the Chambers of Commerce in twenty-six other principal cities in the United States.

Information on Raw Material Supplies

Although the Department primarily interests itself in developing trade in American products it can be of service to domestic manufacturers in connection with supplies of raw materials which necessarily must be imported. With its numerous foreign representatives it readily may be seen that the Bureau can be of distinct aid in furnishing information to domestic firms of conditions surrounding the trade in such materials. A recent occurrence relative to China wood oil will serve as an example.

This oil, as is well known, is a necessary ingredient in the manufacture of water-proof and heat-proof varnishes, and must be imported from the Orient. A new source of supply of this oil was being developed in China, and a sample of the oil, which is of somewhat different grade from that ordinarily imported into the United States, was obtained by the Department of Commerce. The Department has made arrangements with the Institute of Paint and Varnish Research to test these samples, and report on the fitness of the supply of China wood oil for the manufacture of this type of varnish. The Bureau is well equipped to aid domestic manufacturers in securing new sources of raw materials, and to keep them advised of markets in foreign countries with reference to such products.

Statistical Information

The Department can be of further aid to the chemical industry by supplying accurate and detailed statistics of the trade in chemical commodities, both in the United States and in foreign countries. I believe that everyone will concede that it is essential to the intelligent conduct of business to know the extent of domestic and foreign markets, the degree to which these demands are being met, and the countries supplying the products. It is planned that the Chemical Division shall make a periodic analysis of domestic and foreign trade statistics so as to make available the extent of the world's trade in chemical products.

Domestic import and export statistics for chemical products have been greatly improved in recent years, but there remains much that should and can be accomplished in the collection and dissemination of basic statistics of the domestic chemical industry.

A recent gratifying advance has been made in this direction in the case of statistics for sulphuric acid and acid phosphate produced by the fertilizer industry, through the cooperative efforts of the National Fertilizer Association and the Bureau of the Census. That Bureau has published recently statements showing the production, stocks and sales of these products for the first six months of 1922, and, it is reported, will continue the collection of such statistics for six months' periods. It is to be hoped that other branches of the chemical industry will see the advantages of such statistical information, and that it will be only a short time until such statistics have been expanded to include other basic chemical commodities.

Cooperation of the Industry Necessary Trade Associations

I have attempted to briefly describe the agencies within the Bureau of Foreign and Domestic Commerce which can be of service to the chemical industry. The important question now is as to how these agencies can be put to work to render maximum aid to the chemical industry. The Department feels that it can accomplish this in the most effective manner only by receiving the constant advice and counsel of the members of the various branches of the chemical industry. In this connection, the trade associations in the industry can be of a distinct assistance, not only to the Chemical Division, but to the chemical industry as a whole. The various branches of the industry are well represented by such Trade Associations.

It readily can be appreciated that for the Department to keep in contact with individual members of the industry as to information required by manufacturers would be a tremendous task. On the other hand, trade associations could formulate the opinions of their members and present to the Department well matured and carefully prepared suggestions as to the information which would be of maximum service to the industry.

The Executive Committee of the Manufacturing Chemists' Association has agreed recently to act in an advisory capacity to the Chemical Division, and will submit definite suggestions as to the information required by the manufacturers of heavy chemicals in regard to selling these products in foreign markets. As the organization of the Division progresses, it is expected that additional committees will represent other branches of the chemical industry. The Chemical Division can serve the chemical industry effectively only in proportion as it receives the hearty cooperation of all branches of that industy.

Trade associations and individual manufacturers should not wait for an invitation from the Department to cooperate with the Chemical Division. The Division is beginning to function, and has been established for the sole purpose of facilitating contact between the Department and the chemical industry. It is desired that the industry should consider the Chemical Division as a part of the industry itself, and that it is their means of contact with the Government. We want trade associations and individual manufacturers in the chemical industry to feel that they can lay their problems before the Division with the knowledge that their confidences will be respected, and that we will endeavor to aid them in solving these problems by every means at the disposal of the Department.

Destructive Distillation of Lemon Residue

By H. D. Poore

Assistant Chemist, Laboratory of Fruit and Vegetable Chemistry, Bureau of Chemistry, U. S. Dept. of Agriculture

A PROBLEM in the manufacture of citric acid from lemons that never has been satisfactorily solved is the disposal of the residue remaining after the juice has been pressed from the fruit. Probably from 25,000 to 35,000 tons of this residue are produced annually in California. As much as possible of it is disposed of as fertilizer, but growers hesitate to use it in their groves because of the danger of introducing organisms which attack citrus trees and because its fertilizing value is not high.*

The material, consisting of all the peel, pulp and seeds of the lemons, contains from one-half to two per cent of citric acid, depending upon the washing it has received in the juice recovery. This amount of acid, with the hemicelluloses and other constituents present, indicated the possibility of utilizing such waste material during the war for the production of acetone, acetic acid and alcohol by destructive distillation. Even if no profit could be made from the distillation, it might offer an acceptable means of disposing of the waste which is something of a problem at the present time.

Composition of Residue

The composition of a sample taken from 300 pounds of washed residue obtained at a large factory was found to be as follows:

	Per Cent		Per Cent
Total Solids	16.17	Protein (N x 6.25)	1.56
Crude Fiber (Cellulose)	2.73	Pectin	1.95
		Pentosans	2.61
Citric Acid	0.60	Ash	0.82

Moisture determinations made on several other lots of residue secured at different times showed a water content of about 83 per cent.

The Literature

A few references to citric acid were found in the literature and patents on the production of acetone by destructive distillation. According to Thorpe,[1] citric acid decomposes at 175° C., with the evolution of carbon dioxide, the production of acetone and the formation of a residue of aconitic acid. When heated beyond 175° C., an oily distillate appears, which yields crystals of itaconic acid. Robiquet [2] found that acetone was produced in the dry distillation of citric acid. Freydl [3] obtained acetone upon the dry distillation of sodium citrate and caustic lime. Roscoe and Schorlemmer state that acetone is evolved upon the destructive distillation of citric acid with lime. Patents[4] have been granted for the destructive distillation of saccharine or polysaccharide substances, such as sugar beets, molasses and sugar cane, mixed with oxides difficult of reduction, such as those of the alkalies and alkaline earths. It is claimed that the sugar and organic acids are converted into acetone, alcohol, etc., and the nitrogenous matters are decomposed with the formation of ammonia.

Preliminary Distillations

Preliminary destructive distillations made in a small way on the dried residue in Kjeldahl nitrogen flasks showed appreciable amounts of acetic acid and methyl alcohol, and small amounts of acetone The qualitative results thus obtained warranted the construction of a small cast-iron retort, which was made by welding two cast-iron pipes, ⅜ inch thick and 19 inches long, to two circular iron plates. The diameter of the inner pipe, which became the chamber proper of the retort, was 4¾ inches, and that of the outer pipe was 6⅜ inches. The space between the inner and outer shell was half filled with forty pounds of lead, which acted as a satisfactory medium for the distribution of heat from the gas burners. A pyrometer was inserted in one end of the retort and from the other end a pipe was connected with a Kjeldahl flask to serve as the tar condenser. This was joined to a water condenser by a glass tube. Next in line was a flask which became the condenser receiver, followed by another flask partly filled with water for washing the gases.

In order to obtain an idea of the efficiency of the retort, three distillations were made with wood shavings, one with hickory, another with oak, and a third with oak and calcium carbonate mixed. The amounts of acetic acid and methyl alcohol obtained compared favorably with those obtained at the United States Forest Products Laboratory, at Madison, Wisconsin, in a retort 3 feet long and 14 inches in diameter, as reported in United States Department of Agriculture Bulletin 129. The methods of analysis as given in Klar's Technologie der Holzverkohlung and used at the Forest Products Laboratory were used for the determination of total volatile acid, dissolved tar, acetic acid, methyl alcohol and acetone.

Lemon Residue Distillation

Three lots of the lemon residue of 100, 300 and 120 pounds were obtained from a lemon by-product factory. Each lot was found in a meat grinder and a portion was dried over steam pipes on trays. Another part was mixed with over twice the amount of powdered limestone required to neutralize the acid, and dried. As the retort would hold only about 1500 grams of the dried material, it was

*Contribution from United States Department of Agriculture, Bureau of Chemistry, Laboratory of Fruit and Vegetable Chemistry, 148 South Anderson Street, Los Angeles, California.

Bibliography: [1]Thorpe, Dictionary of Applied Chemistry, Vol. 2, p. 71. [2]Ibid. Vol. 1, p. 29. [3]Monatshefte [illegible] [4][illegible] No. 316,060. English No. 15,907.

necessary to make two distillations of each sample, in order to obtain enough distillate to carry out the various determinations on acid, alcohol, etc.

The rate of distillation of the residue conformed as closely as possible to that of the wood distillation, and the temperature was raised to 500° C. with Lots 1 and 3, and to 550° C. with Lot 2. The only difference noticed when the temperature was raised to 550° C. was a continuation of gas production with no noticeable increase in distillate, practically all of which had come off before 400° C. was reached. A small amount of light-colored oil appeared in the condenser receiver at 150° C. and it continued to collect up to 200°, becoming darker meantime. Twenty grams of this oil, equal to 0.3 per cent of the wet residue,, upon redistillation, yielded 10 grams, which boiled between 170° and 180° C. It had a smoky odor and became dark upon standing. As pure lemon oil begins to boil at 172° C., this light oil appearing between 150° and 200° C. is probably the terpenes from the oil in the peel which did not volatilize when the residue was dried. The citral which boils at 228° C. is probably decomposed. The tar appeared in the tar condenser when the retort reached 280° C., at which point nearly all of the distillate had come over. The gas burned at the tip on the wash bottle when the pyrometer registered 270° C. The results obtained on the original wet residue are given in the first part of Table I, and from these results the percentage obtained on the dry residue and shown in the second part of Table I were calculated.

Table I—Results of Destructive Distillation of Lemon Residue

	Lot I		Lot II			Lot III	
	a	b	a	b	c	a	b
		3.3% Limestone		2.2% Limestone	8.5% Limestone		2.2% Limestone
	P.C.	P.C.	P.C.	P.C.	P.C.	P.C.	P.C.
Wet Basis							
Settled tar	1.4	1.5	0.88	1.1	1.2	1.71	1.54
Dissolved tar	0.3	0.3	0.22	0.20	0.18	0.24	0.28
Acetic acid	0.31	0.28	0.22	0.22	0.22	0.28	0.24
Methyl alcohol	0.15	0.17	0.24	0.16	0.13	0.19	0.13
Acetone	0.018	0.018	0.013	0.018	0.024	0.014	0.021
Charcoal	5.8	...	5.2	...	...	6.2	...
Dry Basis							
Settled tar	8.4	9.0	5.3	6.6	7.2	10.3	9.2
Dissolved tar	1.8	1.8	1.3	1.2	1.1	1.4	1.7
Total tar	10.2	10.8	6.6	7.8	8.3	11.7	10.9
Acetic acid	1.86	1.68	1.34	1.34	1.30	1.68	1.44
Methyl alcohol	0.90	1.02	1.41	0.97	0.80	1.10	0.80
Acetone	0.11	0.11	0.08	0.11	0.14	0.08	0.13
Charcoal	34.8	...	31.2	...	...	37.2	...

Comparison of Results

The results show that the mixing of calcium carbonate with both the residue and oak shavings produces only a slight change in the pyroligneous liquor. The acetone is increased at the expense of the alcohol and acetic acid, as shown by (b) and (c) of Lot II, the larger proportion of calcium carbonate producing larger amounts of acetone and smaller portions of acetic acid and alcohol. As the acetone does not increase as much as the acid and alcohol decrease, it would probably not be found advantageous to add the limestone, depending, of course, upon the values of the different constituents obtained.

The amount of acetone from the dried lemon residue is about the same as that from the wood. Only about two-thirds the amount of alcohol and two-fifths the amount of acetic produced from the wood, however, are obtained from the lemon residue.

The characoals and tars were saved from several of the residue distillations. Tests were made with the charcoal to determine its bleaching power showed it to be of no value. After heating to 950° C., or higher, it might give good results, this temperature having been found necessary for the production of the best charcoals. Upon distilling a sample of tar, no fraction of a definite boiling point was obtained.

One ton of the wet residue would yield about 6 pounds of acetic acid, 4 pounds of methyl alcohol and 0.3 pound of acetone. At the present New York prices the value of the pure chemicals would be as follows:

Acetic 6 x \$.095	\$0.57
Methyl Alcohol (95%) 4 x .09	0.36
Acetone 0.3 x .08	0.02
Total	\$.95

In addition, each ton of the wet residue contains about 5 pounds of nitrogen, making it possible to obtain a valuable ammonium salt from the pyroligneous liquor.

From the results obtained in this work, it would be impracticable at the present time to destructively distil the lemon residue at even the largest of the lemon by-product factories. Possibly a factory handling several times the amount of lemons now used may find it necessary to dispose of its waste by burning. Then the value of the chemicals obtained of only a dollar a ton might warrant the installation of a destructive distillation plant, especially if a condition of affairs similar to those of the late war should exist.

The author wishes to acknowledge his debt to Mr. E. M. Chace, who directed the investigation and rendered valuable assistance during the course of the work, and also to Dr. G. C. Spencer, for many helpful suggestions.

William O. Hadley, Rubber-Cement Maker

In 1907 William O. Hadley, of Lynn, Mass., originated and perfected a rubber cement for sticking leather to leather, rubber to rubber and rubber to leather and put it on the market advertising it extensively and continued to do so under his trade name, "3 in 1 Combination Cement," until 1912 when he became associated with Edward F. Beach of St. Louis, Mo. He allowed Beach to use it in connection with the St. Louis Rubber Cement Co. with the understanding that when Hadley severed his connection with the St. Louis Rubber Cement Co. Beach would stop using the brand name, but instead of doing so Beach registered the "3 in 1" brand in the Patent Office, making the statement that he was the originator. In the meantime Hadley had joined the Chemical Research Company and was putting out the "3 in 1" cement to the trade when the St. Louis Rubber Cement Co. brought suit against it for using the "3 in 1" brand label. The case was tried in the Federal District Court in Boston before Judge Johnson who found for the Chemical Research Co., that it had a right to use the "3 in 1" label and that there was no question as to Hadley's originating it.

The Hadleys are a family of cement makers for over 75 years. William Hadley, the grandfather of William O. Hadley being the first man to make rubber cement.

Standardization of Enameled Wares for Chemical Purposes

By Emerson P. Poste
Director of Laboratories, Elyria Enameled Products Co.

EMERSON P. POSTE
Director of Laboratories, Elyria Enameled Products Co.

ALTHOUGH the manufacture of enameled equipment for the chemical industries is a relatively new development in this country, it has advanced to a stage that warrants consideration from the point of view of standardization. Further experience in its construction and use will secure the well merited place which it has already gained among the available types of apparatus for the carrying on of the more exacting chemical operations, whereby it has contributed materially to efficiency of chemical manufacture.

Standard Enamels

The enamels which are used in the chemical and allied industries differ in certain respects from those used for ordinary household ware. A piece which is to serve as a domestic culinary utensil or a sanitary fixture need not have a high chemical resistance, but should possess a particularly pleasing appearance by way of color, gloss and opacity. The raw materials which promote these qualities often do so at the expense of chemical resistance. Heavy metal oxides are commonly used. But for chemical work proper resistance without the use of heavy metals is the prime requisite. A pleasing appearance is desirable but of secondary importance.

Commercial experience has caused the manufacturer of enameled apparatus to offer to the trade a series of enamels with chemical properties suited to the several demands of the industry. From a chemical standpoint these enamels may be grouped in four classes, according to the demands made upon them.

The mildest set of conditions which enameled ware may be called upon to meet involves the handling of materials which are not markedly corrosive but do become discolored or contaminated by contact with the ordinary metals of construction. This grouping includes neutral solutions in general, those slightly acid on hydrolysis, a great variety of organic compounds and a group of materials such as chlorine gas, which, in the presence of traces of moisture, react with metals. Enamels of this type have given satisfactory service in connection with the following typical substances:—Oil during deodorization, alcoholic extracts, aniline hydrochloride, ammonium nitrate during evaporation and fusion, bleach liquor, chlorine gas, dry hydrogen chloride gas, hydrogen peroxide, tincture of iodine, phenol, salicylic acid, acetic anhydride, dry sulphur dioxide, tannic acid, bromine.

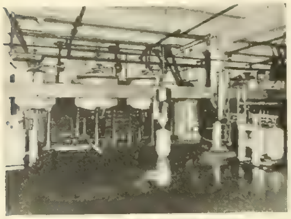
In the second classification conditions demand an enamel with a sufficient chemical resistance to serve under more definitely acid conditions with particular reference to the organic acids as a whole, and traces of free mineral acids. The group also includes solutions actively acid on hydrolysis. As a general rule a metal container would be actively attacked, resulting not only in the contamination of the product being handled, but in the gradual destruction of the apparatus. Typical cases of satisfactory service in this class are the following:—Ammonium sulphate, inversion of sugar, citric and tartaric acids, acetic acid, acid brines, moist chlorine, tin chloride with traces of free hydrochloric acid, zinc chloride, mixed acids relatively low in water content.

The third classification involves resistance to all mineral acids with the exception of hydrofluoric. Contact with a metal container would cause a very rapid destruction thereof. Conditions of more severe acid nature not named in connection with the former classes naturally fall here. Typical cases include hot hydrochloric acid, nitric acid, dilute mixed acids.

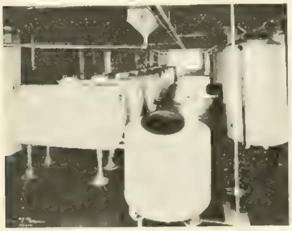
The fourth classification as to chemical resistance of enamels arises from their relation to alkalies. As a general statement it may be said that acid resistance of enamels is promoted by the use of materials which are subject to action by alkali. Experience has shown that ammonia has no appreciable effect on enamels. The hydroxides of the alkali earths are somewhat active. The free hydroxides of soda and potash are quite active, excepting at very low concentrations in the absence of water. Caustic soda solutions under 5 per cent. in strength have been successfully stored in enamel-lined units. The carbonates of soda and potash can be safely handled over quite a range of concentration. Sulphides of these bases are quite active. In general, enamels are not particularly resistant to alkali.

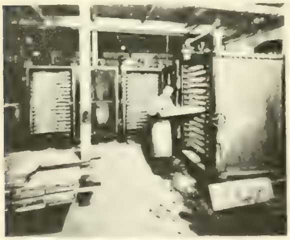
The foregoing consideration has been general. It is difficult to reduce the situation to definite standards. Matters of temperature, type of unit, limitation of size, complication of design and manner of use must be considered in a given case. The more severe the chemical conditions and the more resistant the required enamel, the more difficult is the production of a satisfactory unit. Demands of increasing chemical severity, therefore, must be met by smaller units, simpler designs and more careful operation. A condition that may be safe at atmospheric temperature will be far more difficult at higher temperatures. Conditions that are mild at 50 lbs. steam pressure may be chemically out of the question at a pressure of 200 lbs.

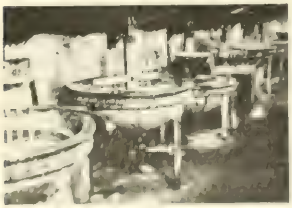
A solution successfully handled by one type of enamel in an open unit may give off vapors more active than the liquid itself, necessitating the use


Syrup Mixing Tanks. Standard for making beverage and medicinal syrups.

Vertical Mixing and Storage Tanks. Extensively used in pharmaceutical work.


Horizontal and Vertical Storage Tanks. Types used in compounding and storage of substances that must be kept away from metal.


[illegible] Widely [illegible]


[illegible]

[illegible]

of a more resistant enamel in a closed unit. Each case must, therefore, be treated by itself. A statement of the essential chemical conditions by the prospective user and a careful analysis of the situation by the manufacturer are required if the proper grade of enamel is to be furnished on apparatus of correct design.

One may logically ask why the most resistant enamel is not used on all types of ware. As a general rule the processing temperature of enamel of a given class increases with an increase of chemical resistance. This in turn greatly multiplies the manufacturing difficulties and limits the maximum size and flexibility of design. To use an enamel of more than the required resistance puts an unnecessary burden on the manufacturer and in turn a higher price on the product.

Standard Construction

As a whole there are two standard types of construction used in the manufacture of enameled apparatus. The one involves the application of a relatively thin coat of enamel to steel, the other a thicker coat of an enamel of a different type to cast iron. Each has its advantages. The steel construction makes possible larger units, but certain manufacturing features limit the larger sizes to mild conditions of use. With smaller pieces more resistant enamels can be used and more severe service met.

The cost per unit volume, however, increases with decreasing size, and other features contribute to the relative undesirability of very small units of steel construction for chemical work. On the other hand, there are various points which make the manufacture of smaller cast iron units very feasible. As a class cast iron enamels process at lower temperatures than steel enamels of the same resistance. Other details go to make this type of construction desirable on certain lines of work. Some manufacturers furnish steel equipment only, others cast iron only, and still others follow both lines.

Standard Uses

The classification of enameled apparatus from the point of view of the chemical operation to be carried on therein is difficult because chemical manufacturing processes deal with such a variety of substances and treatments. It is more logical to consider the standardization of enameled units from the point of view of the mechanical operations being performed therein.

In classifying enameled apparatus in accordance with the mechanical use, five headings may be considered: Mixing, storage, transportation, evaporation and reaction. These standard operations will be considered with reference to the grades of chemical conditions previously outlined.

Mixing

The mixing problem may range from the rapid solution of a solid in a liquid to the formation of a difficult emulsion. The batch may be a few gallons or as large as 7,000 gallons. Chemically it may only be required to keep from contact with steel a product which would be discolored thereby; or possibly acids are present which would rapidly eat through the unit at the minutest metallic contact. For mild service large mixers with complicated agitators of wood or special metals are possible. Conditions of intermediate severity call for smaller units and the use of an agitating device coated with enamel, contact with even small areas of the relatively resistant alloys often not being permissible. Such agitators must be of simple design and operated from the top of the unit. With the most corrosive compounds still smaller units of very simple design must be supplied to assure a satisfactory piece of machinery. The mixing unit may be a single shell tank or it may have a jacket or other device for temperature regulation. It may be of an open or closed top construction.

Typical mixing problems that are successfully met with the proper design of enameled equipment are the following: Mixing of face creams and tooth pastes, preparation of cod liver oil emulsions, mixing of phosphate syrups containing free acids.

Storage

Enamel lined storage tanks are subject to the same general controlling factors as mixing units. They may be horizontal or vertical as desired. A large variety of accessories are possible for tanks for mild conditions while severe acids must be met with simpler constructions.

Among typical materials stored are the following: Edible oils, syrups, elixirs, perfumes, extracts, tincture of [illegible] phenol, alcohol, C. P. mineral acids.

Transportation

The use of enameled-lined containers for transportation on a large scale is at present confined to conditions of a mild nature. Liquors containing free organic acids are being transported in enamel lined tanks on railroad cars. The carrying of smaller batches of liquid from one part of a plant to another is an accomplished fact for all classes of chemical conditions. Open or closed top tanks mounted on trucks or casters find a ready application.

Typical cases of this type include the conveying of chlorinated organic compounds containing free chlorine, the distribution of alcohol to various departments and the carrying of small amounts of mineral acids about the plant.

Evaporation

In presenting the use of enameled units for the evaporation of liquids it is well to have clearly in mind the fact that the evaporation to dryness of large quantities of material, or the rapid concentration of large volumes of solution, cannot be successfully accomplished in this type of apparatus. These problems fall to the drum drier and other relatively complicated devices. The enameled unit has for its field the handling of smaller quantities of the more sensitive or corrosive products.

The simple evaporation problems are accomplished in open units. Evaporation in closed units is usually of the vacuum type. The destructive acids are generally confined to the pan. A variety of accessories may be used on larger evaporators for mild service, but the unit for severe acids must be far more simple.

Distillation, a special case of evaporation, may be carried on at atmospheric or reduced pressures. The plan is essentially the same as the closed evaporator. The condenser and receiver are enameled excepting where severe acid conditions or substances sensitive to metallic contact are confined to the plan. Copper condensers are sometimes permissible.

Another evaporating unit which is finding a growing application in the chemical trade is the enameled tray for the evaporation of liquids or the drying of moist solids. These are used both in atmospheric and vacuum evaporation.

The installation of various forms of enameled evaporators are numerous. A few typical examples will suffice: The evaporation and crystallization of C. P. salts such as thorium nitrate, sodium iodide and copper chloride, the vacuum concentration of fruit juices, concentration and fusion of zinc chloride, preparation of hydrosulphite stripping compounds, concentration of aluminum chloride, evaporation of acid rare-earth bromide solutions.

Reaction

As reaction units are classified those pieces of apparatus in which specific chemical reactions such as nitration or neutralization are carried on. They may be of a great variety of types as conditions demand—open or closed, plain or packeted, large or small. Typical installations involve the chlorination of organic compounds, reduction by metals and acid, preparation of silver nitrate from metal and nitric acid, salting out of dyes, generation of hydrocyanic acid, manufacture of ethyl chloride, processing of acid sodium phosphate, manufacture of so-called "phenol condensation" products.

Standard Temperature Control

Problems of temperature control may involve heating, cooling or holding at a given temperature.

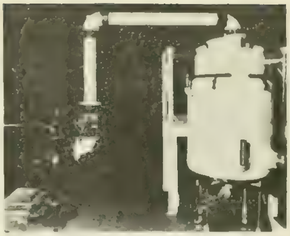
The heating of the contents of an enameled unit is accomplished in various ways. Steam under pressure may be passed directly into the material or it may be applied externally by means of a jacket around the tank or by coils within the tank.

If a jacket is used the allowable pressure is a matter of particular importance from an enamel point of view. Steel has an elasticity by virtue of which it can safely "breathe" due to pressure changes. But the less elastic enamel cannot follow such a movement of the steel without rupture. This point should not be confused with the relative thermal expansion of enamel and steel, to be considered later. A safe working pressure for an enameled unit may be taken as about one-half of that which would be reasonable for the same structure unenameled. In the case of jacketed vacuum units proper correction for vacuum must be made.

If the allowable jacket pressure under a given case does not furnish the desired temperature, superheating may be resorted to.

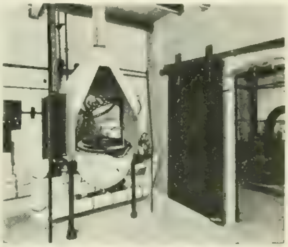
Under chemical conditions which will allow the use of a metal steam coil within the the batch more rapid evaporation or higher temperatures can be thus realized by using high pressure steam. Such coils are commonly furnished in plain copper, nickel-plated tinned or silver-plated copper or aluminum.

Certain types of reactions demanding high temperatures but relatively low heat absorption are often made possible by the use of oil as a heating medium. Oil heated in a separate heater may be circulated through the jacket



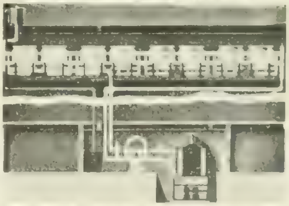
Vacuum Pan for the Concentration of Food Products, as jams, jellies, and other delicate, slightly acid materials

Large Reaction Kettles. Transportation Tanks for chlorinated organic products.



Tilting Reaction Kettle with Agitator. Heated by circulating oil.

Large High Temperature Reaction Kettles for blending of hard waxes



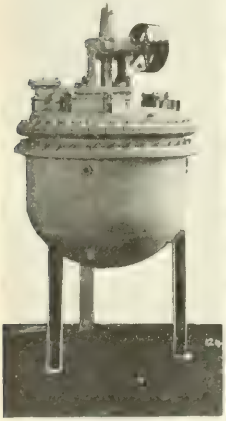
[illegible]

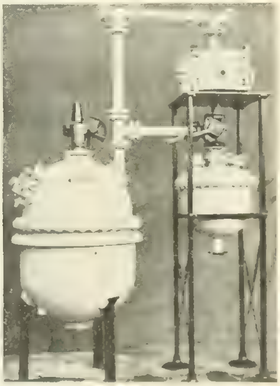
[illegible]

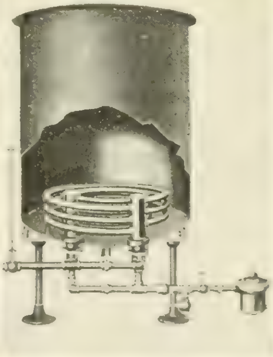
or through metal coils within the batch. Oil in the jacket may be heated by direct fire applied to the bottom of the jacket or by high pressure steam in coils within the jacket. Specific conditions, chemical and mechanical, will govern the procedure in a given case.

Some reactions demand higher temperatures than can be obtained by steam jackets, a more rapid flow of heat than would result from the use of oil as a heating medium and involve chemical conditions such that metal coils are out of the question. Such situations have been successfully met by the use of a bath of molten alloy, heated by a fire beneath.

A final possibility for the production of high temperature is the use of direct fire. As a general rule, this method is undesirable. Enamels of the proper composition have a thermal expansion so related to that of the metal beneath that the two materials can pass through a reasonable temperature change without the setting up of strains causing rupture of the enamel. But if the temperature change is severe and local, trouble may result. No conditions existing with allowable steam pressures or oil heating temperatures should cause distress. But with direct fire the heating is liable to be locally excessive, causing severe strains on sudden changes of temperature. Under conditions of evenly applied heat, accomplished by proper checker work or baffles, very satisfactory service can be realized. Small units heated over a flame of low intensity applied to a large portion of the dish are found to be very practical. If the material being treated has a relatively low thermal capacity—for instance, an oil as compared with an aqueous solution—conditions of excessive strain from direct fire heating are less liable to be produced.


Jacketed Reaction Kettle with Agitator. For [illegible] operation [illegible] [illegible] [illegible] controls.


Reaction Kettle and Still Condenser [illegible] [illegible] [illegible] [illegible] [illegible]


Open Evaporation Unit with High Pressure Steam Coil. For the rapid concentration at atmospheric pressure.

Vegetable Oil De-Odorizer. Heated by hot oil in jacket. Superheated steam [illegible] bottom.

The problem of the cooling of a liquid is not frequently encountered. In a few cases cold water or brine have been circulated through jackets or coils. Condensers are usually equipped for the circulation of water or brine.

It is often desired to prevent the rapid exchange of heat between a unit and the atmosphere. Air confined in a jacket or the use of the common insulating materials are frequently resorted to.

A statement as to the rate of heat transfer through enameled metal is pertinent. The partition through which heat is passed [illegible] may range from a thin coat of enamel on one-eighth-inch steel to a relatively thick coat on one-inch cast iron. Hence, the rate of heat transmission varies between quite wide limits. As a maximum it is approximately one-half and as a minimum about one-fifth that of copper. These values are on the assumption that the same conditions as to temperature difference, velocity and other factors exist. The comparison also refers to copper of the thickness used in the construction of apparatus for similar operations.

Thus it is seen that by the combination of various standard elements of design, enamel, method of temperature control and accessories, equipment can be constructed to serve a great variety of purposes. While a given piece of apparatus may differ from any previously made, it usually embodies only standard features assembled to meet a particular case. The would-be purchaser does well, therefore, in recognition of these facts, to submit his case clearly and fully, so that the manufacturer may intelligently make such a combination of standard elements as may best suit the case in hand.

Insection pests, unfavorable economic conditions surrounding the handling of the raw materials, development of the synthetic product, and price concessions of the Formosan product have resulted in the abandonment of commercial cultivation of the camphor tree in the United States where in Florida and adjacent Gulf States climatic conditions were favorable to its growth. The Bureau of Plant Industry, U. S. Dept. of Agriculture, worked in conjunction with the Celluloid Co., which established a 2,000 acre plantation near Palatka, Fla., and with E. I. du Pont de Nemours & Co., which sought to develop a 10,000 acre plantation near Greencove Springs, Fla., but neither enterprise ever reached a commercial stage. The chemist has produced from the turpentine of the region favorable to the growth of the camphor tree a synthetic camphor, the commercial manufacture of which in the United States, in competition with the government controlled natural camphor of Japan, will be determined by the measure of protection the industry is accorded by the Government.

Service of the Technical School to Industry and the People

Enterprise of the School of Chemistry, North Dakota Agricultural College, in the Promotion of Technology and Sound Merchandising in the Paint and Varnish Industry and in the Education of the People in the Quality of Its Products

By Dr. W. T. Pearce
Head, School of Chemistry, North Dakota Agricultural College; Paint and Varnish Chemist, North Dakota State Laboratory

DR. W. T. PEARCE
Head, School of Chemistry, North Dakota Agricultural College.

THE paint and varnish work at the North Dakota Agricultural College in North Dakota may be classified under three heads, viz., investigational, educational and law enforcement or regulatory. The research phase has to do with ascertaining the relative values of the several materials used in the manufacture of paints and varnishes. The educational phase deals with the training of technologists for this industry and with the teaching of the people of the state concerning the relative values of these materials through the public press and through bulletins. The regulatory phase deals with the initiation and the enforcement of paint and varnish laws.

Historical

In 1905 the Legislative Assembly of North Dakota enacted a paint law. During the legal proceedings undertaken to determine the constitutionality of this law, it was noted that little data were available concerning the durability of the several paint pigments. In order to obtain some reliable information upon this subject, a fence was erected upon the college campus in 1906. In the 1907 Report of the Food Commissioner, we find the following statement relative to this fence:

"The paints used in this test comprised various paste leads, a number of the leading brands of mixed paints sold in North Dakota (usually the white and gray of each brand being selected), mail-order house paints and some special tints, yellow, green, blue and red. As far as possible the directions on the cans or accompanying literature were followed."

These paints were applied on white pine, hard pine and cedar. This work was started under the direction of Dr. E. F. Ladd, then Professor of Chemistry and Chemist of the Government Experiment Station. Dr. C. D. Holley, who is now Director of Research for The Sherwin-Williams Company, was placed in charge of the experiment work.

In 1907 the Paint Manufacturers' Association of the United States offered to cooperate in the construction of more test fences, using a more comprehensive series of formulas. They advised the using of typical manufacturing formulas in three colors, white, gray and colonial yellow. They furnished the paints and further cooperated by furnishing funds to help defray the expense of the work and by sending committees of experts to help with the inspections of the fences. These fences were constructed in 1907 and the reader is referred to our bulletin No. 81 for a detailed description of them.

They were inspected in 1908 and 1909 by committees representing the College, the Paint Manufacturers' Association, the International Association of Master Painters and Decorators of the United States and Canada, The Picher Lead Company, and the National Lead Company. The very complete reports upon the inspections are found in our Bulletins Nos. 1, 2, 3, 4, and 92. The repainting was done in 1911 and an excellent review of the work and the condition for repainting is found in Scientific Section Bulletin No. 31, Educational Bureau of the Paint Manufacturers' Association by Mr. L. P. Nemzek.

Proceeding simultaneously and in close cooperation with these investigations, two other important lines of endeavor began. The one was the course in paint technology in the college proper for students enrolled in chemistry, and the other the education of the public in the use of high-grade paints. From 1907 to 1919 some eighteen men were graduated from this branch of chemical technology. A study of the careers of these men from the time of their graduation to the present time indicates that care was taken in the selecting and training of these men. At any rate, they are found in responsible positions in the paint and varnish industries.

In this brief historical review mention must be made of the men who were responsible for this pioneer work. Dr. E. F. Ladd is now U. S. Senator from North Dakota. Dr. C. D. Holley is the author of monumental works upon the analysis of paint and varnish products as well as the Director of Research for The Sherwin-Williams Company. Professor E. E. Ware is superintendent of the varnish plants for the same company. John Dewar is still an official of the International Association of Master Painters and is known the country over for his good work in paint circles. Dr. Henry A. Gardner is the author of a large number of excellent bulletins upon paint and varnish topics and is Director of the Institute of Paint and Varnish Work, Washington, D. C. George B. Heckel, who helped formulate the paints, is the secretary and treasurer of the Paint Manufacturers' Association. L. P. Nemzek is technical director, Paint Division, E. I. duPont de Nemours & Co. Three of these men were on the college staff and the others were representing the cooperating associations.

Recent Work

In 1915 and 1916 four hundred and eight outside white paint formulas were used upon what is known as our 1915-1916 Test Paint Fence. These were formulated and painted under the supervision of W. F.

Washburn, who was the paint chemist at that time. These tests include comprehensive studies of the durability of the common paint pigments in nearly all possible combinations and studies of a fine selection of special oils with typical pigments. This fence was inspected several times by the writer and a complete report of the inspections and the conclusions drawn is found in our Bulletin, Vol. I, No. 4.

Since then two new fences have been constructed, one in 1921 and one in 1922. Upon these fences will be found a repetition of some of the more important former tests and most of the new pigments in a number of combinations in white and in tints. Now metal and porch paints are being studied in a similar way. Sloping roofs have been constructed and panels of galvanized iron, and tin painted with various test formulas, are nailed upon them. Likewise fir boards have been fashioned to make a porch effect and they are painted with a series of test paints.

Within the past few years varnishes have been added to the list. The writer began with a study of methods of chemical analysis upon varnishes of known composition. Now, a thorough study of physical testing is in progress in conjunction with exposure tests upon maple panels. Sixty typical varnishes are being studied. It is hoped that a national basis for evaluating types of varnishes will be found by this method.

Chemistry Building, North Dakota Agricultural College

Instruction in Paint and Varnish Technology

During the past few years the School of Chemistry has gone on developing the course in paint and varnish technology. It has an experimental paint and varnish plant, with presses, mixers and stone and iron mills. It uses the several test fences and panel racks for instructional purposes. The student completes fundamental courses in the usual branches of chemistry, mathematics and engineering during his first three years. In his senior year he begins with a thorough study of paint and varnish raw materials, tests, specification, methods of analysis. He then manufactures two gallon samples of white and tinted paints. He practices tinting, refining of oils and he makes typical varnishes in two-gallon quantities. Then follow tests upon the finished product. In the class room, the instructor follows similar lines, including a study of operation costs, types of machinery, etc. Within the past three years eighteen men have graduated from this course to enter the paint and varnish industry.

Believing that there was still another way of serving the state as well as the paint industry, we are offering this year a trade course in painting. Complete painting outfits and a spray painting outfit are being secured. A master painter of long experience will have charge of most of the work.

In addition to this work, instruction in other branches of chemistry is given. Some specialize in physiological, organic and agricultural chemistry; in fact service courses are given to over 400 students.

Inspection and Popular Education

Another feature is the inspection work. In 1905 samples of paint were collected in various parts of the state and analyzed. Many of these contained large amounts of water, some as high as twenty-four per cent., and brands of paste, labelled "white lead," contained no white lead at all. Then several cans were short in volume. High percentages of inerts in mixed paints were quite common. Today a large number of samples are collected by state inspectors in all parts of the state, analyzed in our laboratories, and the results are published in bulletins which are widely circulated. The data obtained show the result of our effort, which is carried on through local papers and through bulletins, to educate the retail dealers and consumers as to the kinds of paints (not brands) to use and how to interpret the formula label upon the package. In our last report, it was noted that the average percentage of inerts, such as barytes and silica, was less than twenty. In other words, the retail dealers are carrying in stock mostly high-grade paints. We have as many calls for technical bulletins from paint salesmen as from technical men or users.

Cooperation of Paint Manufacturers

Too much praise can not be given to the paint manufacturers for the fine way in which they have cooperated with us. Many have formed the opinion that the paint and varnish industry is much less scientific and progressive than the other branches of chemical technology. Since taking charge of this work the writer has spent his vacation in various paint and varnish plants and laboratories, and has had the pleasure of meeting most of the technical men in this industry. He has found them progressive; he has seen plants almost entirely under complete chemical control; and he has found a willingness to aid any phase of investigational work that would help either the people or the industry or both.

I frequently am asked why we should train paint and varnish technologists in North Dakota. The answer is simple. Paint investigations initiated to protect the people and honest manufacturers led to paint and varnish legislation and to the installing of experimental plants and laboratories. This brought about ideal conditions for establishing a course in paint and varnish technology. It was by continuing these investigations, and by educating the people at large, that the course developed. In this program the law enforcement division under Director W. C. Palmer, works in complete cooperation with the College staff. All of the research and analytical work is directed by the writer in addition to the instructional work.

The Patent Situation Abroad

By Dr. Alfred Müller
Member, American Patent Law Association

RECENT discussion of the foreign patent situation has been with such poverty of authoritative information as would lead any one unfamiliar with the patent practice in foreign countries to believe that American inventors in particular were treated unfairly and that to apply for foreign patents was so fraught with difficulties and so expensive, that, in view of the subsequent requirements for maintaining the patent, foreign patents had better be left alone altogether by American inventors. The writer, who has practiced as a patent attorney for twenty-five years and in the last twenty-three years has specialized in foreign patents, believes that some explanation is due to the readers of this publication from one who can speak on this subject with wide experience.

Patents in European Countries

As far as European countries are concerned, an examination as to the novelty and the usefulness of an invention is conducted only in some of these countries, to wit: Austria, Czecho-Slovakia, Denmark, Germany, Great Britain, Holland, Hungary, Norway, Poland and Sweden. In all the other European countries, viz: Bulgaria, Belgium, Finland, France, Greece, Italy, Luxembourg, Roumania, Spain, Switzerland and Turkey, patents are issued without any previous examination as to novelty and usefulness, so that no extra expenses are incurred in those countries through "the usual procedure of prosecution," provided, of course, that the application papers are properly prepared.

While it is true that in a large number of European countries the patent, when issued, takes its date from the day when the application was filed, it must be kept in mind that in the countries which dispense with an examination as to novelty and usefulness of the invention, the grant is assured without any procedure of prosecution, and, as a rule, the patent is issued within a year from the date of the application, so that the term of the patent is not shortened to any considerable extent. That because of the abnormal conditions created by the unfortunate war delays have occurred and are still occurring, especially in the newly created States which have lacked any organization to take care of such matters, is a condition which will more and more disappear as each nation recovers its economic life.

In any event, that from 2 to 10 years are required to obtain a foreign grant is a fairy tale absolutely unsupported by facts. Leaving out of consideration the abnormal conditions following upon the war, patents are granted in practically all European countries with reasonable dispatch, leaving the term of the patent unimpaired even where the patent dates from the day of application. In a number of European countries, however, to wit: Austria, Czecho-Slovakia, Denmark, Holland, Portugal, Roumania, Spain and Turkey, a patent is dated from the day of grant, so that the term of the patent remains entirely unabridged irrespective of the length of time the application has been pending in the office.

The writer knows of no case in his own experience where it required 10 years, or even approximately that period of time to obtain a foreign grant, Russia included, where grants were notoriously slow. If an application has been filed in the proper form and with proper claims, in the first instance, and is diligently prosecuted, where such prosecution is required, because of the novelty search, the grant of the patent usually can be obtained within one year and certainly within less than two years.

In Great Britain, the time of prosecution is limited by law, and a patent must issue within the prescribed period of time, or an authorized extension, which, however, still remains well below two years.

In the new States, like Poland, Czecho-Slovakia, Jugo-Slavia, Esthonia, etc., which never had a Patent Office before, the procedure naturally is extremely slow, but this is only due to inexperience and lack of properly trained officials. The statement that "On the present basis American inventors receive patent protection in many foreign countries for a period which is only one-half to two-thirds of the period for which a United States patent is granted," even when making allowance for the delays occurring in the grant of a European patent, is untrue.

The term of a United States patent is 17 years. Austria grants patents for 15 years, running from day of grant; Bulgaria, 15 years; Belgium, 20 years; Czecho-Slovakia, 15 years, running from day of grant; Denmark, 15 years, running from day of grant; Finland, 15 years; France, 15 years; Germany, 15 years; Great Britain, 16 years; Greece, 15 years; Holland, 15 years, running from day of grant; Hungary, 15 years; Italy, 15 years; Luxembourg, 15 years; Norway, 15 years; Poland, 15 years; Portugal, 15 years, running from day of grant; Roumania, 15 years, running from day of grant; Spain, 20 years, running from day of grant; Sweden, 15 years; Switzerland, 15 years; Turkey, 15 years, running from day of grant.

As regards the statement that "In order to maintain the grant, the inventor must pay taxes and working fees," let it be understood that while taxes must be paid not only by American inventors, but by inventors of all countries alike, on European patents obtained by them, there are no official working fees, except in Spain, where an official certificate of working must be obtained. An inventor, whether an American inventor or not, who has obtained a patent in any of the European countries, is obliged by law to work, within a fixed period of time, the invention either himself or have it carried out by others in the country which granted the patent, because for failure to do so the patent may be revoked, provided some party having an interest in the invention being carried out, files a petition to that effect, which petition, however, must be supported by proofs that the non-working of the invention is prejudicial to the interests of the "home-industries."

In a number of European countries, however, the law contains a compulsory license clause, whereby an inventor, who, for some reason or other, does not work the invention himself, can be compelled to grant a license or licenses to others who can show proof that they are in the position to work the invention and who, of course, must pay to the inventor a royalty. In Great Britain, patents can be endorsed "Licenses of Right," whereby the inventor or patentee is not only freed of all obligation to work the invention in Great Britain, but moreover derives the further advantage that the taxes on his patent are reduced by one-half.

Germany, as is well-known, has a treaty with the United States, recently revived, which provides that American inventors are freed from the obligation of working their inventions in Germany, if the invention is worked in the United States.

Patents in Non-European Countries

As regards the legal provisions relating to patents in non-European countries, it may interest the readers of CHEMICAL AGE to know, that in Canada, Newfoundland, Mexico, Cuba and in most Central and South American countries patents are granted for the full term fixed by law without the requirement of paying taxes. Canada grants patents for 18 years; Mexico for 20 years; Newfoundland for 14 years; whereas in many of the South American countries the term is elective.

In Australia, only one renewal fee, payable at the end of the first seven years is required, while in New Zealand two renewal fees only, one at the end of the first 3 years and the other at the end of the first 6 years are payable. In order that a valid patent may be obtained, it is very important that the invention has not received any publicity of any kind prior to the filing of the application.

International Patent Convention

Almost all the European countries with a very few exceptions, and further Mexico, Brazil, Ceylon, Japan, Australia, New Zealand, Tunis, Cuba, Dominican Republic, Trinidad and Dutch East Indies, are parties to the so-called International Convention. One of the articles of this Convention provides that the inventor who has filed an application in one of the States adhering to the Convention can claim the priority of this application in the other Convention States, provided that in these other Convention States his application is filed within 12 months from the date when his first application was filed. Such an application filed within the Convention period is considered as having been filed on the same day as the said first application so that if in the meantime any publicity, either with or without the consent of the inventor, has occurred, the patent when granted will not be invalidated thereby.

While the application is considered as having been filed on the day of the first application, yet the patent when issued will bear date either of the day when the application was actually filed or of the day of grant, depending upon the legal provisions of the particular country. In Great Britain, however, the patent in such a case will be dated from the day of the first application which becomes important because at the end of 15 months from the date claimed under a Convention application, the complete application is placed on view to the public, whether the application has been accepted or not, and shortly afterwards printed copies of the specification, claims and drawings are sometimes placed on sale. This is a point that should not be overlooked in connection with applications that may be contemplated in other countries, because of the publicity connected with the issue of such printed copies.

In a few European countries a patent of importation can be obtained which will be valid and will have the same force and effect as a patent of invention, in spite of any previous publicity, so long as the invention has not come into actual use in the country in which the patent of importation is applied for. Such patents of importation are issued in Belgium, Italy, Roumania and Spain. In the last named country, the patent of importation is limited to 5 years, whereas in the other 3 countries, the patent expires with the first foreign patent.

South America

While the law in all the South American countries requires novelty of the invention, it is possible to vindicate a foreign patent in Argentina, Brazil, Chile, Colombia, Ecuador, Uruguay and Venezuela. In Brazil the time for validation of a foreign patent is limited to seven months from the date of grant, and in Uruguay to twelve months. While in the other countries there is no time limit, it is generally understood that the patent must be applied for, before the invention has come into use in said country. Bolivia and Peru require novelty of the invention in that the same must not have been so described and shown in publications that it can be put into operation. Official disclosure by the printing of the patent specification elsewhere is not held to be a bar to a valid patent in Bolivia and Peru. The procedure for Paraguay is to have either the Argentine, Bolivian, Peru or Uruguayan patent confirmed, as in Paraguay patents are otherwise granted only by special Grant which takes a long time, and is rather costly.

Working Clause of Foreign Patents

A word still may be said regarding the working provisions contained in most foreign patent laws, according to which, a patented invention should be carried into actual practice within a specified time ranging from one to three years counted from the day of grant. The purpose of these working provisions is of course to give the benefit of the invention to the nationals of the country in which the patent was obtained. If a patented invention is not put into actual use within the specified time, any interested party may file a petition for the revocation of the patent. In most countries the patentee can set up a defence if he can show that he has made bona fide efforts to have his invention made accessible to the public.

This can be accomplished in various ways, and is usually done by way of advertising the patent for sale, or offering a license under the patent and by addressing manufacturers in the particular line to which the invention refers. Such a procedure is called "formal working" or "constructive working," and if it is frequently repeated, say at least every year, it will serve as a defence in the event that a Petition for the revocation of the patent on the ground of non-working is filed. Such advertising also will bring the patentee in touch with manufacturers abroad, and will lead some time to a sale of the patent or to some advantageous arrangement regarding the manufacture of the invention.

As a rule, no official recognition is taken of the working of a patented invention, and so long as the annuities or yearly taxes are paid, a patent will continue in force, whether the invention covered thereby is being actually worked or not. In a few countries, however, a certificate of working must be obtained from the Government if the patent is to be kept in force, or an official extension of time must be obtained, which extension is usually granted for a period of one year, and can be had in most of those countries upon a mere application to that effect. In Canada, however, where an invention must be carried out within two years from the date of the grant, good and sufficient reasons must be shown why the patentee has failed to put the invention into practice.

The requirement of annual taxes and the working of an invention may often prove irksome, especially where patents have been obtained in a large number of foreign countries. The writer has always adhered to the belief that the payment of annuities should not be exacted from a patentee for at least the first five years of the life of the patent, because of the difficulty and the time consumed in making an invention commercially valuable. In most of the Central and South American countries no annuities are required, and it is to be hoped that in the course of time European countries will modify their patent laws so as to give the patentee a breathing spell, if not to abolish the system of annuities altogether.

Manufacture of Carbon Bisulphide

By Geo. A. Richter
Research Department, Brown Company

LARGE-SCALE production of carbon bisulphide is based upon a direct union of two elementary substances, carbon and sulphur, such a union taking place from 600° to 1,000° C. At these reaction temperatures the sulphur obviously is present as a vapor and the unreacted carbon exists as an incandescent solid. Care must be used in selecting the type of carbon for successful operation. In the writer's experience, gas coke, anthracite coal and other forms of dense carbon have proved of little use. Best results are possible with a reasonably good grade of willow or birch charcoal, which has a low ash content.*

It is important that both sulphur and carbon employed be as dry as practicable. Water brought into the furnace as moisture in the sulphur reacts with the sulphur in the high temperature zone, forming hydrogen sulphide and other volatile sulphur compounds. These side reactions evidently convert sulphur into useless products at the expense of some heat.

Water present in the charcoal delivered to the furnace is usually distilled from the furnace at a temperature lower than that needed for reaction with sulphur. This is due to the fact that charcoal is usually introduced into the furnace at the upper low temperature zone in order to conserve heat by employment of countercurrent principles. This calcination of charcoal results in a certain small loss of heat as will be discussed later. It is also of importance to specify a well-burned charcoal. A poorly burned product contains substantial amounts of hydrocarbons which cause loss of both heat and sulphur, due to the formation of useless sulphuretted compounds, which distill off with the carbon bisulphide. In practice it has been found profitable at times actually to dry and reburn some of the charcoal purchased before putting such charcoal into the furnace.

The general layout of the installation described is shown diagrammatically in Fig. 1. The furnace consists of a cast-iron shell lined with a suitable grade of refractory. Provision is made for water-cooled electrodes, through which power is furnished from a two-phase 440-volt A. C. line. Transformers and switchboard allow voltage changes in 10 volt steps, such changes being made either to control production or to adjust total power input as the internal electrical resistance of the heating bed varies from time to time.

A resistance bed of broken arc-light carbon is distributed over the entire cylindrical space between the electrodes. The heat generated is conveyed from the incandescent bed of resistor carbon to the charcoal above.

Sulphur is fed into the furnace from a melting kettle. It is fed through a liquid seal and delivered near the center of the hot zone, where it is vaporized instantly and reacts with the hot charcoal present.

Charcoal is introduced periodically as needed by means of a suitable hopper through the top of the furnace shell. Carbon bisulphide, hydrogen sulphide and other sulphur compounds leave the furnace and enter a condenser where the bisulphide is recovered, and the impurities are washed out continually by means of overflow water.

Attempts have been made to control the temperature of the furnace by means of pyrometers. Peep holes, however, have proved fully as satisfactory, and represent considerably less maintenance costs. The usual maximum temperature is about 1,000° C.

The unit diagramed below will produce one ton of carbon bisulphide in twenty-four hours with a power consumption of 0.5 to 0.7 Kw.H. per pound of washed material recovered. The principal losses of electrical heat and chemicals may be listed as:

1. Radiation of heat from surface of furnace including electrode losses.
2. Loss of sensible heat in exit vapors.
3. Loss of heat due to melting and vaporization of sulphur which leaves the furnace as unreacted sulphur and worthless sulphur compounds.
4. Loss of chemical accompanying heat loss listed under 3.
5. Loss of carbon bisulphide due to leaks and solution in wash water.

In calculating distribution of heat losses, it is important to have available values for the chemical losses which represent heat consumption without the equivalent yield of product. It is fair to estimate a sulphur loss represented by items 4 and 5 as totalling 20 per cent of the original sulphur fed to the furnace. This is equivalent to an 80 per cent yield of washed carbon bisulphide, based on original sulphur used, and must be accompanied by an additional 20 per cent power consumption over that theoretically required for the production of carbon bisulphide actually recovered.

---

*From a paper presented at the Montreal meeting of the American Electrochemical Society, Sept. 21-23, 1922

Knowing the radiating surface, average shell temperature, and the recovery of carbon bisulphide per twenty-four hours, it is possible by making a reasonable assumption for the heat conductivity coefficient to estimate the loss due to radiation. . . .

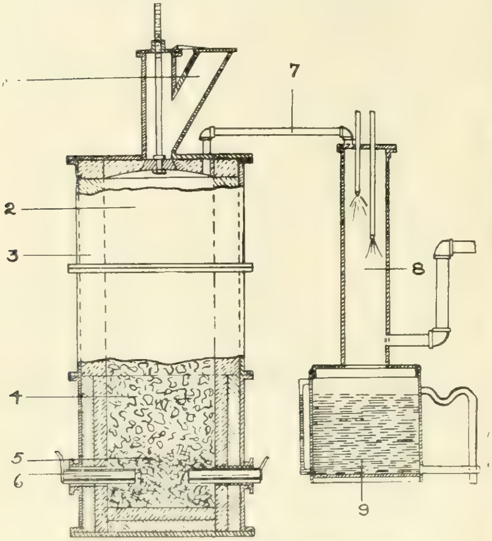


Fig. 1. Diagram of Carbon Bisulphide Process

1. *Charcoal Hopper.*
2. *Furnace.*
3. *Refractory Lining.*
4. *Charcoal.*
5. *Resistance Carbon.*
6. *Electrode.*
7. *Delivery Pipe.*
8. *Condenser.*
9. *Product.*

The heat requirement for the production of 1 kilogram of CS_2 in the furnace described above may be summarized as follows:

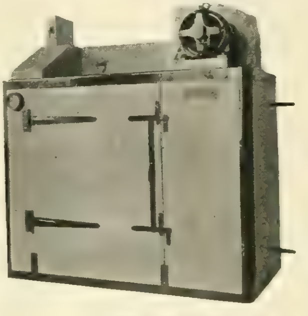
1. Heat of formation of 1 kilo finished CS_2	320,000 cal
2. Loss due to drying charcoal.............	5,000 "
3. Loss of heat due to subliming S. which leaves furnace in worthless form........	97,000 "
4. Radiation loss	610,000 "
Total electric heat input..................	1,032,000 cal.

The tabulated heat balance indicates a thermal efficiency within the furnace amounting to about 31 per cent. Converting calories to Kw. H., it is possible to express our results as 1 kilogram of carbon bisulphide produced per 1.20 Kw. H., or 1 lb. per 0.73 H. P. H. These values agree well with actual operating data.

It is quite evident that the largest loss of power is due directly to radiation losses from the furnace. Any increase in capacity of the furnace tends to lower the per cent radiation loss and increase the efficiency. The maximum capacity or output per unit time is limited by the maximum allowable sulphur sublimation loss. A point may be reached where added load may increase prohibitively the cost of operation due to loss of chemicals, as well as increased maintenance costs. With current prices of chemicals and hydro-electric power it may actually prove more profitable to operate the furnace at a somewhat lower thermal efficiency and to sacrifice efficiency for equivalent financial return.

Dryers for Fine Chemicals

Drying of finished or intermediate products in the various branches of chemical manufacture calls for temperature and moisture control and such facilities as will permit the least dependence upon manual labor and assure the maximum output in quality and quantity of product. The well-known house of B. F. Sturtevant Co., Hyde Park, Mass., have introduced for use in the chemical industry an added line of cabinet tray and compartment truck dryers, here illustrated, which answer the requirements of efficiency in the procedure of drying in fine chemical manufacture. The cabinet tray dryer is adapted for drying small quantities of such chemicals as dyestuffs, pigments, pharmaceuticals, etc. The compartment truck dryer is used for handling large quantities. In its adaptation to plant requirements, the latter type can be enlarged to accommodate any number of trucks or can be built of the progressive tunnel type in which there may be definite zones or sections in which are maintained different conditions of temperature and humidity, without any sacrifice of the efficiency and economy of the former or cabinet type of dryer.



Cabinet Tray Dryer

Compartment Truck Dryer

The framework of the dryer is built in sections of structural steel angles and housed tight with heavy galvanized iron sheets covered with insulation 1½ in. in thickness. Heating coils are built with staggered pipes and are separated from the drying chamber by means of a baffle plate. Circulation of air is effected by means of a motor-driven fan. The type of dryer and material treated determine the air-supply system and method of circulation. The positive circulation of air insures uniform distribution and equal air velocities across or through the material. The compartment truck dryer illustrated is installed in the Brooklyn, N. Y., plant of the Ault & Wiborg Co., for drying aluminum hydrate.

Robert A. Milliken, physicist, director, Norman Bridge Laboratory, California Institute of Technology, has been appointed a member of the Committee on Intellectual Co-operation, which, under the auspices of the League of Nations, is to study and suggest methods of intellectual co-operation throughout the world. Dr. Milliken succeeds Prof. George Ellery Hale, director, Mount Wilson Observatory, Pasadena, Cal., who resigned from the commission.

Uniform Cost Accounting in Chemical Industry

NOTABLE in the accompanying chart of the Fabricated Production Department of the Chamber of Commerce of the U. S., in which is visualized the progress of its efforts in the establishment of uniform systems of cost accounting, is the absence of marked growth in the chemical industries of dyes, explosives, flavoring extracts, paper and pharmaceuticals, while in fertilizers, ice cream, meat packing, paints, pottery, preserving, printing ink and tanning, equally distinctive as chemical industries, progress has been considerable.

Inasmuch as each industry has problems peculiar to itself a uniform cost system that will fit all industry is not practicable, but in a given industry production conditions are sufficiently uniform to permit the reduction of cost-finding methods to a standard procedure that will give comparable results for both large and small manufacturers. The importance of a uniform cost system in a given industry under present competitive conditions warrants the utmost encouragement to the Fabricated Production Department of the Chamber of Commence of the U. S. in promoting the extension of the practice.

Uniform cost accounting strengthens the position of the industry in dealing with governmental or regulatory bodies; it inspires confidence that selling prices are determined upon a fair and equitable basis; it solves authoritatively disputed points of accounting within the industry; it makes possible a more intelligent competition; it reveals lines within the industry which have been marketed on an unprofitable basis; it shows the danger line below which goods cannot be sold at a profit, thus serving as an insurer of profits; it acts as a common guide to the value, efficiency and waste of workers, machines, methods, operations and plants; it becomes a reliable guide and basis for estimating prospective business, thus acting as a forerunner for comprehensive production statistics; it furnishes current reports for comparing major cost items with standards, which are predetermined and thereby measuring and increasing operating efficiency; it establishes a standard code of accounting practice, so that if your cost clerk or bookkeeper leaves you, his successor will step into a system whose operation has been fully and completely formulated.

A uniform cost system will give the manufacturer comparable results. That is to say, it will give him assurance that the other manufacturers in his line have included and excluded the same items into costs; that their enterprises have been substantially departmentalized in the same way as his own; that there exists a common treatment of overhead, a tying up of the financial and cost records, a control of raw materials. In other words when the manufacturer studies his summary of manufacturing cost, he will be able to say that A, B and C are figuring their cost in the same way he is, and that the differences in costs that may exist are based on superior efficiency and not because of cost ignorance.

The promotion of uniform cost accounting is one of the prime functions of trade associations, which is exemplified by the growth of the system in those industries most conspicuous in trade association activity. The accompanying chart shows graphically what 109 commodity lines have been doing in the direction of uniform cost accounting. The chart is practically limited to manufactured lines; no attempt is made to cover distribution.

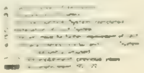
Of the 109 commodities specified, 23 have only proceeded to classification of accounts, an additional 30 lines have formulated fairly complete cost systems, 38 have proceeded with the installation and 24 lines are adequately providing for the further improvement and development of their uniform cost systems. From the analysis of these campaigns for uniform cost accounting and the contact the Fabricated Production Department has had with over 200 industries certain general truths may be deduced.

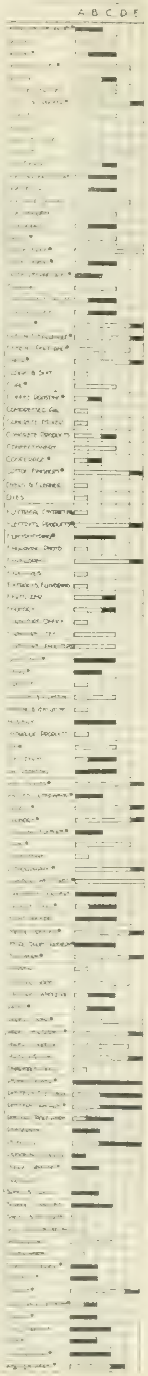
Immediate results must not be expected from a campaign for uniform cost methods. There is a considerable period necessary for cost education so that the interest of the manufacturers in a particular industry will be gradually aroused to the point where they will demand uniform cost accounting rather than to have it thrust upon them.

Before proceeding with the establishing of uniform methods of cost determination it is necessary definitely to have in mind the objective; in other words, what it is hoped to accomplish, whether the cost accounting is to be used as a basis (a) for establishing individually fair selling prices, or (b) for establishing departmental or commodity costs and profits, (c) for increasing individual efficiency, or (d) all three.

Before attempting any widespread improvement of the cost accounting in an industry it will be necessary to ascertain the stage of development of cost accounting in the industry, whether it is in the job cost stage, the process stage, or in the standard cost stage.

The interest of the members of a trade association must be aroused to demand the uniform cost system, rather than have it thrust upon them.





II. Random Recollections of an Old Professor

Men and Events of the Early Days of the Segregational Activities of American Chemists, with Reminiscent Observations of Some Well-Known Figures in American Chemistry.

By Edward Hart, Ph.D.

Professor of Chemical Engineering, Lafayette College

MY first contribution to the chemical journals was printed in the *American Chemist* in 1875. This was followed by a second in the same journal in 1876, and a third in the *Chemical News* for 1876. At the Johns Hopkins my thesis subject for the degree of Ph. D. was on Nitrosulphobenzoic Acids. This was printed in the first volume of Remsen's new *American Chemical Journal*.

American Association for the Advancement of Science

In those days the only meeting place of American chemists was at the meetings of the American Association for the Advancement of Science. I became a member at the Philadelphia meeting in 1884. Chemistry was known as Section C. The presiding officer of the Section was a vice president of the Association. Our vice president that year was John W. Langley, of the University of Michigan. Dr. Langley was a brother of the secretary of the Smithsonian Institute. His inaugural address was a consideration of the nature of affinity, preceded by a history of the growth of the idea. Langley was one of the early physical chemists. Among the papers read at the Philadelphia meeting was one by Dr. H. W. Wiley on the analysis of milk; one by C. F. Mabery; another by L. M. Norton, and C. O. Prescott, E. H. S. Bailey, Arthur H. Elliott, W. O. Atwater, Dr. Alfred Springer, C. E. Munroe, Clifford Richardson, Helen C. de S. Abbott, James Dewar, Albert R. Leeds, H. C. White, H. Leffman, C. W. Dabney, J. F. Heyes and F. P. Dunnington also presented papers.

Dr. H. W. Wiley

Dr. Wiley at this time was head of the chemical laboratory in the U. S. Department of Agriculture. His character and attainments are so well-known to this generation that I scarcely need describe them; and yet I know him so well and in so many ways that it may not be amiss to say a few words about him. I knew him first at the Buffalo meeting in 1886, when he was vice president of Section C, and the center of all the fun.

Wiley has a kind heart. He noticed that I took part in some discussions with fear and trembling and singled me out for marks of kindness which I never have forgotten. I think Springer, W. L. Dudley, Wiley and I visited Niagara together and so became acquainted. In 1893 he visited me in Easton and asked me to become editor of the *Journal of the American Chemical Society*. He had just been made president of the Society.

At that time my *Journal of Analytical and Applied Chemistry* was in its seventh volume and was a paying investment. I needed the money and told him so, but promised to give his proposition some thought. I finally concluded it was my duty to accept and did so. Then some of the New York chemists grew angry and said that Breneman, the former editor, had not resigned. This placed me in a very unpleasant position, as I had already begun work. The matter was soon adjusted by Wiley, but I afterward discovered that I was blamed for driving out Breneman by some of his friends. From that day to this some of the New York crowd have had no use for me. I have not been able to discover whether this was an aftermath of this misunderstanding or of some other.

Editorship of the Journal of the American Chemical Society

It was not before the month of June, 1893, that I finally got to work as the editor. At that time there were two papers in the drawer and six numbers in arrears. Wiley had asked me either to consolidate my journal with that of the Society or to edit both. I declined the latter alternative at once.

I always supposed and still think that the chief reason for my selection as editor was to add to the membership through the subscription list of my journal. This was the result: Wiley busied himself in getting papers and I saw to the printing, and by the end of the year we had printed and distributed 12 journal numbers.

In 1894 I published the first volume of Wiley's Principles and Practice of Agricultural Analysis. This gave me a unique opportunity for gauging Dr. Wiley. I found him to be steadily kind, patient and laborious as well as perfectly fair. He never blamed the printer when he was in fault himself.

In many subsequent visits at my home and in my visits to his home in Washington we have grown to be warm friends. This has been strengthened by the fact that in my old days I, too, have taken up farming for the sake of my children and because I love it. It is a pleasure to know such a man and an honor to have been his friend.

Dr. Alfred Springer and Section Q

It was at the Buffalo meeting that Springer read his paper on the torsion balance, now so widely used. At the Philadelphia meeting he had read a paper on Fermentation Without Nitrogen, which he had observed. He thinks that the observed fact may be explained by the presence of an organism which takes up nitrogen from the air, thus anticipating the work of Hellriegel and Wilfarth. At the time we all thought Springer had made a slip; I am not so certain now.

During the sessions Springer was attentive and earnest; afterwards he was the jolliest of them all, ready for any funny prank. I saw him many times at these meetings, and liked him. Our sessions were held in the morning and afternoon. This gave us nearly a week of free evenings, many of which, as we were away from home, we spent at the sessions of Section Q. This was a Section not listed on the official program. It was held at some place selected by careful scouting, where the best beer could be had, and here the faithful of all the sections met to drink beer and exchange stories.

I was not much of a beer drinker, but I liked to hear the stories and get acquainted with the famous men from my own and the other sections. It was here that I met Major Powell, Alvin Clark, Brashear and many other famous scientific men who were not chemists. During the meetings there were many excursions to places interesting to the members of the various sections. I often went with the botanists and became acquainted with Dr. and Mrs. Britton, with Coulter, and I had the good fortune to become acquainted with Dr. Le Conte at the Madison meeting. It was like seeing the world to meet these men in familiar conversation, for had I not read and enjoyed their books?

DR. H. W. WILEY
Chief, Bureau of Chemistry, U. S. Dept. of Agriculture, 1883-1912

The Brittons and Dr. Thomas Conrad Porter

I met Dr. and Mrs. Britton on several occasions afterward. Our Professor of Botany at Lafayette was Dr. Thomas Conrad Porter. He was a distinguished botanist and numbered the Brittons among his friends. Together we visited the Poconos in the spring looking for new and rare species. One day as we were crossing a pasture field Mrs. Britton suddenly called out: "Here is *Botrychium simplex!*" I had never seen this but soon secured a considerable number of specimens, nearly all of which I turned over to Dr. Porter.

Dr. Porter was also Professor of Geology at Lafayette. He was an interesting man, full of odd notions. One of them was that peaches and azaleas would not grow on the limestone. I succeeded in raising some beautiful peaches on the limestone, which I sent to him with the label: "Raised on the Limestone;" next time I saw him he smiled and said: "Those were fine peaches." I tried my best to raise an azalea on the same soil, but did not succeed after many trials.

There was a story on the campus to the effect that Dr. Porter used to go on the middle floor of Pardee Hall whenever he saw a thunder storm approaching so as to be protected by the maze of iron pipes. Dr. Le Conte told me that when he and Dr. Porter were much younger they had been together on an excursion in the Carolina mountains. At the close of a long, dusty ride they stopped at a mountain hotel and retired to their rooms. Presently the thunder began to mutter and Dr. Porter, clad only in his shirt and a pair of spectacles, rushed into his room in great alarm.

Among the older men of Section C was Dr. A. B. Prescott, of the University of Michigan. He limped and walked with a cane. He was tall and spare and very dignified, but also very kind in manner. He was supposed to be strictly temperate and did not attend the meetings of Section Q.

Dr. Henry C. Bolton

Dr. Henry Carrington Bolton was a very constant attendant. He was a man of means, but was ambitious to do good scientific work. It was he who organized the meeting of chemists at Northumberland to celebrate the centennial of Priestley's discovery of oxygen. Bolton wrote many papers on the history of chemistry. He was a man of charming personality. His work on the bibliography of chemistry is notable. I have a copy of his "Bibliography" which has survived one rebinding and badly needs another.

Dr. F. W. Clarke

Dr. F. W. Clarke was a constant attendant. He was very precise in statement; quite impassive in manner; very witty and very careful to keep his statements well within the bounds of what was positively known. This is rather amusingly shown in a paper he once read before the American Ceramic Society on "Problems in Silicate Chemistry" printed in the 15th volume of their Transactions for 1913.

He says: "I am expected to tell things which I do not know, and I have a large and varied assortment of that kind of information which would take much more time to relieve myself of than I am at liberty to spend . . . The more I have considered the group of minerals known as clays, the kaolinite, montemorillinite and perhaps a dozen others, the more I think of them and study them, the more I am convinced that I know very little about them. I thought I knew something at one time, but I have come to the conclusion that the amount of my knowledge is extremely small." Clarke was at one time something of a politician and wrote "A Politician's Prayer" which was printed many years after in *Chemical and Metallurgical Engineering* (Vol. 16, p. 13).

American Ceramic Society

Speaking of the American Ceramic Society reminds me that I had something to do with the movement by which it was started. I think it must have been in 1897 that a young man came into my office and introduced himself as E. C. Stover, a cousin of Harry Stover, one of my schoolmates at Doylestown. He told me he was in the pottery business at Trenton, that a number of potters had organized a class for their own improvement in the art and they would like to have me tell them about the chemistry of their operations.

I told Stover that I was quite ignorant of the art and science but that I was willing to make a try at the game if they were. This was reported satisfactory, so we held, I think, ten meetings at the Normal School in Trenton. It was an odd experience. There were 17 in the class with ages from 17 to 70 and all grades from owner to clerk and kiln boss. I began by telling them I knew as little about potting as they did about chemistry but we would try our best to exchange.

One of the kiln bosses told my friend that "that young squirt didn't know a d—— thing." He proceeded to demonstrate this by showing me a piece of ware which he said was part of the rim of a bath tub, badly blackened, and asked me what caused it? I took the piece home and found the black material was soot. I told him I didn't know the cause but my guess was that when the fire was started the muffle had become filled with soot which had deposited in the ware, that the temperature had risen so rapidly that the glaze had fused over it before the carbon had time to burn. It so happened that my guess was correct and my reputation was increased out of all proportion to its deserts.

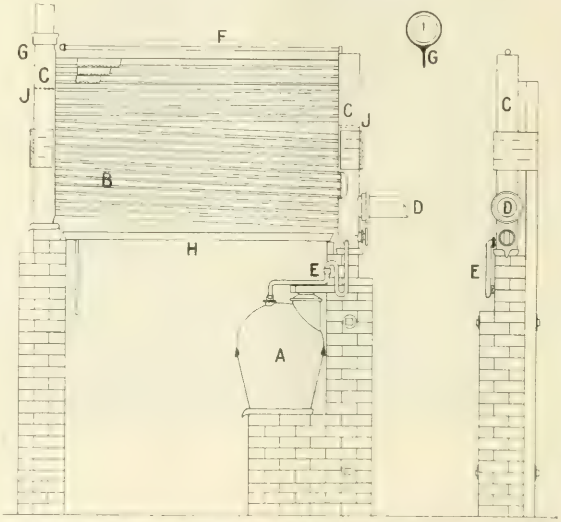
This class, I believe, was the beginning of the movement which led a few years later to the organization of the American Ceramic Society which held its first meeting at Columbus, Ohio, in February, 1899. The officers were Herbert A. Wheeler, president; Ernest Mayer, vice-president; Edward Orton, Jr., secretary; Stanley G. Burt, treasurer, and William H. Zimmer, Samuel Geysbeck and Chas. F. Binns, managers. These men and others who were associated with them have transformed the industry completely. At the suggestion of my friend, Stover, I became a member in 1902. In this year I published for the Publication Committee of the Society, of which Stover was Chairman, an English translation of the Works of Dr. H. A. Seger in two large volumes.

Karl Langenbeck's "The Chemistry of Pottery"

In 1895 I had published "The Chemistry of Pottery" by Karl Langenbeck of the Mosaic Tile Co., Zanesville, Ohio. This book of Langenbeck was an excellent treatise and was of considerable importance in the development of the scientific side of potting in America. It was an extension of two papers published by Langenbeck in The Journal of the American Chemical Society for 1893. In the first of these papers Langenbeck says: "Our potters are, almost without exception, innocent of chemical knowledge and American chemists have had little opportunity of working in their manufactories, or have not felt at liberty to publish their experience in such lines of work." This truly expresses the conditions at that time—a great contrast to those now obtaining.

I Go Abroad

I made my first trip abroad in 1895. I had invented and patented my nitric acid condenser in 1894. A paper had been read before the World's Congress of Chemists at Chicago in 1893. It is of interest that one of the audience was Georg Lunge. Dr. Lunge took part in the discussion of the paper and evidently considered the condenser of little value. In the world war, however, practically all the gun cotton made by the du Ponts was made from nitric acid made with this condenser as well as a large part of that made in England and elsewhere. It was to introduce this condenser to the English manufacturers that I went abroad.



DESIGN OF DR. HART'S NITRIC ACID CONDENSER

[illegible] deflects its through the four glass tubes into the right-hand standpipe which collects the condensate. The remaining uncondensed vapor now passes to the left through [illegible] perforated pipe F.

I took several letters of introduction to English chemists and particularly was indebted to Thomas Tyrer, who took great pains to see that I met those I wished to meet. Among others I met were Dr. Thorpe, Dr. H. E. Armstrong, Sir William Crookes and Sir Joseph Swan. William McNab became our English agent and introduced the condenser into the chemical trade.

While I was in England I was the guest of Dr. Armstrong at dinner. Many of his friends were present and after dinner all the children came in and shook hands. They were a fine lot of youngsters and I did not wonder at his pride in them. Dr. Armstrong has been a great power among the English chemists. He still retains his vigor as shown by his recent article on the progress of chemistry in the three extension volumes of the Encyclopedia Britannica and the biography of Messel just published in the Journal of the Society of Chemical Industry.

Sabbath on the Thames with the Thorpes

During the stay in London I spent a Sunday with Dr., now Sir Edward, Thorpe on his steam yacht in a trip on the Thames. Mrs. Thorpe, Dr. Thorpe's secretary and a young friend of the family also were of the party. "Amy and "Annette were out in full force, and there were some amusing scenes at the locks on the river. We carried our lunch in a hamper and after our return Dr. Thorpe and I carried the hamper to the train and from the station to his home on Notting Hill where we had supper at ten o'clock.

Since then I have contributed the article on "Nitric Acid" to his Dictionary of Applied Chemistry. I have had several letters from him recently, all in long hand written by himself. R. W. Raymond was like him in this respect and wrote most of his letters himself in long hand.

Abroad Again

During a subsequent visit to England in 1903 I attended the meeting of the Society of Chemical Industry at Bradford where, on behalf of the New York Section, I invited the Society to hold its next annual meeting in New York. This invitation was accepted. Of course this gave me an excellent opportunity to meet those chemists whom I did not already know. I saw something of Sir William Ramsey, then in the zenith of his reputation, and heard him announce the discovery by Rutherford and Soddy of the radium emanation. This was at the annual dinner where I was given a place to the left of the Mayor of Bradford who wore as his badge of office a heavy gold chain. Many of those present at Bradford came to New York the following year and I met them again.

DR. WILLIAM H. NICHOLS
Chairman, Allied Chemical & Dye Corp.

Dr. and Mrs. Julius Leukowitsch in New York

Among those who came to New York were Dr. and Mrs. Julius Leukowitsch. He was famous as the author of the "soap-boilers bible." Julius was immensely popular. He was a Pole, one of the always cheerful, with a good word for everyone. Mrs. Leukowitsch was equally accomplished. At one of the dinners she was chosen by the ladies to express their thanks and made a charming address.

Dr. William H. Nichols

It was in 1895 that I first met Dr. Nichols. At my invitation he and Herreshoff came to Easton to see the nitric acid condenser in operation. They were pleased with it and said so. Mr. Nichols asked me whether we had taken out Canadian patents. I said, "No, we have not." He informed me that they wanted several condensers, but that they were wanted for use in one of the Canadian works. They would not take advantage of the fact that there were no Canadian patents but I must please remember that when we sent in the bill. This attitude pleased me very much. Herreshoff, too, I discovered, belonged in the same class. As Nichols said afterward: "He is so straight that he leans over backwards."

In 1900 we sold the business of the Baker and Adamson Company to the General Chemical Co. I was opposed to this but my partners insisted. Subsequent events have shown that I was correct and that we might have developed a great business had we retained it. For nearly 15 years we carried on the business but in 1915 fear of the Sherman Act, probably, determined that the management be transferred to New York.

I saw a great deal of Mr. Nichols during this time and found him uniformly just and considerate. At my suggestion our Trustees made him an LLD. He was pleased and asked me whether he might make me a present of a college gown; I said "No." I did not wish it should be possible anyone might be able to say that he had bought his degree. During the last war it became necessary to raise $10,000 at once to pay off a college debt. I was made chairman of the committee and we succeeded in raising $8,000. Then I wrote to Dr. Nichols and told him the story. By the next mail a letter came with his check for $2,000.

Some Editorial Experiences

For several years as editor of the *Journal of The American Chemical Society* I was associated with Edgar F. Smith and J. H. Long on the Editorial Committee. Smith is a bully fellow but he hates so badly to turn a man down that as a buffer for the editor he was a failure. Long was more satisfactory but I had to shoulder most of the responsibility myself for refusing to print. Not a few of those whose papers were declined with thanks refused to accept our verdict without a row. We were several times invited to state the "Principles" which guided us in printing or refusing papers but avoided committing ourselves to any general principles.

Dr. McMurtrie was a great stickler for economy. He worked without pay himself and insisted that the others do so also. As a result of this I had the magnificent salary of $250 as Editor and, I think, an equal allowance for postage. This $500 was more than eaten up by odds and ends of expense so that during the nine years of my editorship I received nothing for my work.

My editorship was of great benefit to me, however, because I learned so much as a result of it. I was able after a time to appreciate at their true value many things which before I could only guess at. It was also in some ways a period of disillusion, for not all chemists are unselfish.

Before concluding this sketch I must speak of Dr. Chandler with whom my relations were never intimate. This was simply because we seldom met. At a later date, after 1900 I think, he was good enough to come to Easton to lecture to the chemists. We found him the kindest of men, generous to the last degree in bestowing time, effort and money without the slightest expectation of return.

The Dudleys

I think I should also say a word about the two Dudleys, C. F., who was at Altoona with the Pennsylvania R. R., and W. L., at Vanderbilt University. C. F. Dudley was a warm friend of Dr. Drown. When I gave up my Journal he conducted the negotiations with me on behalf of the Directors of the Society and I was struck with the fairness of his dealings and the sincere desire to do his plain duty, which marked all his work. When he married we gave him a farewell dinner in New York. Here he showed his great mind and heart by asking us to drink the toast: "Here's to the dearest girl of all—but one."

W. L. Dudley I got to know better still. In a great variety of ways he showed me little kindnesses when I began to go with the chemical crowd and felt strange. He was greatly beloved by many of his students, much as is Edgar F. Smith, and like Edgar he knew their names and faces—he was interested in them; they were his friends. He was, however, a severe judge. The slightest deviation from what he thought correct led to the withdrawal of his favor. This was so pronounced as to be amusing. His early death was greatly lamented by a very wide circle of sincere friends.

Dr. E. W. Morley

Neither must I omit to speak of Dr. E. W. Morley who for several years was the center of chemical interest. His work on several fundamental atomic weights and other constants was of such importance and was so laborious and successful as to command our interest and approval. But he was interesting in other ways. At the Buffalo meeting of the A. A. A. S. he was President. His work had been attacked with great virulence by a member from St. Louis. He referred to this in his inaugural address, but first asked me to read it over to get my judgment as to whether he had been harsh. I said I thought he had not. After the address had been delivered I congratulated him and said: "You did not say all you wrote." "No," said he, "I though I had better not say so much."

Several years later Dr. Morley was made President of the Chemical Society, against the wish of McMurtrie who thought him too mild. At our first Council meeting several very knotty questions had to be solved. Morley said: "We will get a first approximation." This was put to a vote and decided with great unanimity. Then we got a second approximation. By this time all difficulties had disappeared. Several years afterward he lectured for me in Easton. Later with a party of young friends I visited Dr. and Mrs. Morley at their home in West Hartford, Conn. They were delighted to see us and we had a wonderful visit.

Bicycles, Beer and the Boys

I think it was at this Buffalo meeting of the American Chemical Society that a lot of us made a visit to Niagara. Springer, J. M. Porter, Jas. Lewis Howe, Parsons and several others were in the party. We were on bicycles traveling against a head wind. We grew thirsty and a drink of beer was suggested. So we stopped at a road house and Parsons registered us as "Jesse James and seven brothers." Most of the party grew tired and came back by train, but Porter and I rolled back into Buffalo on our "bikes."

L. M. Dennis, of Cornell, was at this meeting. One evening we all went to a vaudeville, but there was too much horseplay, so we adjourned to a bowling alley where Dennis won the prize. Then we tried pool and billiards and he won at both and was adjudged the best all-round sport.

I think in this brief account of my friends and associates I inadvertently have omitted several who deserve mention. I have not tried to speak of those I first met after 1900 for they belong to a later generation—the present. I count myself fortunate in having known so many so well, and in having been able to learn from them so many things which did not belong to chemistry but form a part of the lessons we all should learn.

Canadian Institute of Chemistry

By ELLIS I. FULMER, F.C.I.C.

Associate Professor of Bio-Chemistry, Iowa State College

Shall there be established in the United States an organization of similar purposes and ideals to those of the Institute of Chemistry of Great Britain and of the Canadian Institute of Chemistry?

In view of the many excellent articles published in the CHEMICAL AGE relative to the above question, it would seem that I can contribute very little unless it be in the way of reminiscence.

It was my good fortune to be a member of the Toronto Section of the Society of Chemical Industry during the days of the inception of the Canadian Institute of Chemistry. I shall never forget the serious and thoughtful meetings during which the ideas were evolved. It is not often one's privilege to sit in meeting where the leaders seem consecrated to a cause and all feel small before the main issues. The Canadian Institute of Chemistry was born in an atmosphere where pettiness was absent. And these meetings were regular meetings of the Society of Chemical Industry. There was no talk of the possible inconsistency of the old and inclusive Society and the new and exclusive Institute.

More than once I have been asked, "Did not the industrial concerns resent the effort to dictate whom they should hire?" As a matter of fact, many of the prime movers of the Institute were the heads of large industrial concerns. Their idea was: "Now if you chemists would only be labelled so we could know whom we are hiring we should all be much happier." The letters F. C. I. C. and A. C. I. C. are such labels and protect both the concern and the chemist; the concern hires others at its own risk.

I have been asked about those men without the opportunity for a college degree but who are worthy in every way of the name "Chemist." Such men may be granted the letters F. C. I. C. upon the passing of an examination before a committee. Some of the greatest enthusiasts for the Institute are these "self-made" chemists who now are put on an equal basis with their brothers with the college degree. The letters F. C. I. C. and A. C. I. C. are degrees in chemistry granted by chemists, to chemists, for chemists.

The New Jersey Zinc Co. has presented to the Department of Mining and Metallurgy, Columbia University, a complete working model of a Hegeler furnace for roasting zinc ore. James Ellwood Jones also presented to the same department a model of a coal mine

Chemical Segregation in America

AT the Birmingham meeting of the American Chemical Society a "reorganization" committee was appointed whose duty would be to study conditions and to report recommendations of plans for the reorganization of the Society, whereby it might reflect the needs and aspirations of the rank and file of American chemists without disturbance of that centralization of control which has made it powerful as an educational society.

Rarely in technical journalism has there been such coordination of courage, opportunity and capacity as has favored CHEMICAL AGE in promoting the organized consideration of the material welfare of chemically trained men. Here is an example of constructive journalism which took shape in the advocacy by CHEMICAL AGE of an independent professional economic organization of chemically trained men dedicated not to scientific education, which was well provided for, but to standardizing capacity, to inculating ability to sell it, and to providing a helpful, human agency to guide the chemically trained man in his material growth; briefly to do for the chemically trained man what is done, e. g., for lawyers and physicians by the professional societies of law and medicine; to give the practitioners of chemistry a definite professional status by the creation of a strictly economic organization dedicated to the control of conditions too frequently baneful of material development that the scientific educational society in the performance of natural functions, creates.

The frank discussion in these pages of the most important subject that could engage the consideration of chemists created some resentment on the part of a few who believed that the sun of managerial intelligence of American chemistry moved in a rather circumscribed orbit and shone directly upon those especially qualified to determine what is best for American chemical organization and American chemists. With the realization that the facts and principles promulgated by CHEMICAL AGE simply expressed the convictions of the great majority of American chemists, activity was displayed to mollify this opinion in the fear that the growth of a strictly economic organization to function as a professional society might create such division of interest as would be inimical to the growth and service of the scientific society.

The large body of men who demand the strictly professional organization are members of the scientific society and, while equally demanding that it be supported for its educational service, insist as well that the functions of an organization designed to correct and control the conditions created by the scientific society never can be performed with such satisfaction of service as to justify their control by the centralized, unresponsive government of the scientific society.

Not only has CHEMICAL AGE instigated the appointment and activity of the "reorganization" committee of the American Chemical Society, whose chairman, our good friend Dr. Mory, states will have its report ready for the New Haven meeting of the Society in April but it has indicated, by a poll of 2,029 votes to 95 votes, that the professional economic organization of American chemists shall be separate and independent of the scientific society, but with such coordination as shall be of the maximum mutual helpfulness. An organization of hired men never can work out their problems as they should be worked out to make the professional society of any great value to its members in an uncongenial environment of incompatible purposes.

For three years CHEMICAL AGE has laid down the fundamental principles of growth to American chemists. There is too much done for American chemists that doesn't amount to anything beyond the creation of a popular glamour that merely embarrasses. The anointed fight shy of the things that should be done and condemn all effort to provide an effective agency for doing them, in the obsession that progress most is served by confining all segregational activity to a single organization. Plainly violative of the principles of growth is such obsession. What men value most is what they themselves create. Doing things for men, handing down concessions to popular opinion in the group as a sop to their desires, provides no such exercise as strengthens men.

What the American chemist needs the scientific society can not provide, because the employing element does not wish to encourage the only sort of solidarity that will be of any benefit to a great class of educated men, turned out in increasing numbers with no plan or system as to their demand or utilization; and should not attempt because of the necessity of concentration upon its primary educational purposes, without the embarrassment of contradiction of functions, if the fullest measure of efficiency is to be attained.

The outlook that can see a single bureaucracy as the proper agency of service to the educated men in the great field of the science, art and business of chemistry plainly is perverted, for it turns its back on precedent and genuine service to embrace the fetish of organization which seeks to sooth men in their desires and to discourage and deprive them of opportunity to do things that will disturb the system.

American chemical education and American chemical industry demand today as they never have done before that there shall be a strictly economic organization whereby the product of the former and the conditions of the latter shall receive the consideration that only an economic professional organization dedicated to the material welfare of the member can render. Commonsense, good judgment and an instinct for service that puts men above methods, dictate this conviction and compel the opinion of the futility of benefit to the rank and file of American chemists of a hybrid organization which only can repeat the experience of all hybrids.

Permit us to submit the description of conditions attending the formation of the Canadian Institute of Chemistry, as set forth by Dr. Clark, F. C. I. C., of the Department of Chemistry, Iowa State College, on page 460, in contrast to the misrepresentation and subversion of the principles of the American Institute of Chemistry and the resultant disservice to American chemists and American chemistry.

The American Institute of Chemistry simply is repeating in its formative period the development of the Institute of Chemistry of Great Britain. Canadian chemists were wise to the lessons of history and hospitable to the teachings of experience. The Chemical Society of London labored long, but the foremost strictly professional society of chemists is the result. The controlling group of the American Chemical Society waives aside all the half-century's experience in segregational obstetrics and condemns this prolific mother to the agonies of a frustrated birth.

CHEMICAL
AGE

Volume 30
Number 10

October
1922

A Consolidation of
The Chemical Engineer
and Chemical Age

EDITORIAL

INSTEAD of the "blaze of glory" in which well-puffed and supposedly well-supported affairs usually are announced to end, the Eighth Annual National Exposition of Chemical Industries folded its tent, and its exhibitors departed in a state of uncertainty that, with a very considerable number, found expression in dissatisfaction with the management.

When everybody is doing business and making money a good spirit prevails. Likewise when an instrument of publicity which, from the standpoint of the business man in the chemical and chemical equipment and supply fields has its sole sanction in originating new business, falls short in what its patrons may have been led to expect, the dissatisfaction which ordinarily would demand a transfer to another agency finds expression in the criticism of the existing agency and in the promotion of the creation of another.

This dissatisfaction has not been confined to the present exposition. Its boldness of expression on this occasion simply is the result of growth as the causes which give it rise become more prominent. These causes are fundamental and will continue to create dissatisfaction until they are removed. Commentators who seek to express in print the varied opinions on the subject overlook the prime defect of the Chemical Exposition as it is conducted at the Grand Central Palace by the International Exposition Co., and that is the distribution of exhibits over several floors.

So long as are maintained conditions that favor a few, who embrace some who are in receipt of perquisites and privileges, so long will there be justifiable criticism of the Grand Central Palace as a show place for the business and progress of chemistry. Certainly the present management cannot be held responsible for the physical limitations of the structure, but it is these limitations of the show place which to a great extent have bred the evils of commission and omission with which the present management is charged, and which have resulted in a serious movement to change the entire [illegible] of the Chemical Show.

This movement does not rise solely out of dissatisfaction with the management and the methods of the exposition, however impellant it may be. It is a phase of the economic adjustment of the period through which chemical industry is passing in which men move under the command of efficiency more insistent than in days but shortly remote when goods rather than price was the desideratum, and in which novelty to the people has been displaced, as regards the Exposition, by monotony of attraction and, as regards chemistry, by satiety of propaganda.

Pronounced in this period is the impulse to get 100 cents for every dollar of expenditure and the fact that chemical industry has begun to feel its oats in the growth of trade associations within the industry, whereby, like all prudent men, it demands to profit from its experience and not to be satisfied to work for the profit of a management which has looked upon it as an oyster to be opened. With increasing sharpness has come to be defined that line of demarcation between service to an industry and working an industry.

Accordingly, prominent exhibitors of the chemical industry, and of the equipment supply industry which is the backbone of the patronage of the exposition, are convinced of the practicability of the conduct of the Chemical Exposition as an annual publicity institution of, by and for the chemical and allied industries on a cooperative basis, for which there are numerous successful precedents. Many exhibitors belonging to the Manufacturing Chemists' Association, American Synthetic Organic Chemical Manufacturers' Association, Chemical Equipment Association and the Scientific Instrument Manufacturers' Association favor this movement, from which commendation flows the uncertainty as to the outcome of the dissatisfaction with which the Chemical Exposition closed.

WITH the constructive steps already taken by representatives of exhibitors to hold the next chemical exposition on a basis of actual cost to the exhibitor and in a way that will assure the largest measure of equitable treatment, whether he provide raw materials, equipment, or is engaged in chemical manufacture or in the educational enterprise of the industry, and in a way that truly will portray the status and possibilities of service of chemical industry, there doubtless will be more or less initial duplication of effort inevitable to the process of survival of the fittest.

There can be only one permanent chemical exposition. Shall this be managed by representatives of the four classes of exhibitors in close coordination with the trade and scientific organizations of the field, as the capstone of the educational enterprise of the industry itself; or shall it be managed as a money-making enterprise whose promoters in their endeavor to assure financial success to themselves resort to methods as fruitful of antagonism from the disfavored as of loyalty from the favored?

There is one thing that the personnel of American chemical industry is outgrowing and that is slavish following of the shrewd minority and of agencies that cash-in bountifully on the sheep-like subserviency of the unorganized mass. With hard times comes circumspection and a realization that things often are not what they ought to be. Institutions lose their sacrosanction in the disclosure of their sordid methods to repress and distort criticism of the conventional. Our humble reflection is that there is vastly more to the desire to seek to do a thing right by doing it yourself than is involved in the location or square foot cost of floor space in the Chemical Show.

IN no field of effort are the intimacy and interdependence of the University and Industry greater than in applied chemistry. Just as progress in the latter sets the pace for enterprise in the former, so the fecundity of the teacher and researcher often in the first instance has pointed the way to this progress. Naturally by virtue of this intimate coordination the chemically trained man retains a lively interest in the problems of the educator, for is he not the educator's product by whose behavior not only is the quality of his work judged, but the fitness of the man himself for the educative process displayed?

The overtaxed facilities of cultural and technical education, despite the rapidly growing investment in its provision, have laid upon the educator problems analogous to those that beset the men themselves in their introduction and growth in industry. In the study of these problems two schools of thought have arisen, viz., the aristocratic and the democratic, each of which has the virtues and vices inherent in its analogue in political government. According to the former school, advanced education is a privilege earned only by fitness to receive it; according to the latter, equality of educational opportunity shall be withheld from none that each may be advantaged by the measure of his gifts, regardless of the burden laid upon the institution.

Just as in manufacturing, which requires a certain volume of production before many efficiency methods economically can be installed, so in education numbers are essential that there may be a field for selection that fitness for the educative process can be made the test for admission. With many educational institutions this condition has become imperative in a sense never felt before. Chemically trained men are interested in this situation particularly as tests may be developed to determine the candidate's fitness for work in chemical industry or in any other highly specialized field, whereby the failures of maturity may be lessened by the early elimination of those moved by the propaganda-inspired enthusiasm of immaturity.

The most important step in life is the selection of a vocation. The time now demands that the guess-work of youth seeking preparation for professional pursuits shall be replaced by the judgment of qualified vocationalists. Quality, not numbers, is demanded of the practitioners of chemistry. In the strict enforcement of this principle by institutions of chemical professional education, they perform not only a prudent service to chemical industry but contribute greatly to the success of the individual and to the professional status of the class.

WITH the organization of the Chemical Equipment Association by manufacturers of chemical plant equipment and accessories, the last grand division of chemical enterprise has yielded to the influence of the trade association as an agency of government within the industry.

Basic and essential as production equipment manufacture is to chemical industry, that it is the last field to organize itself may be explained by the diversity of its products and by that individualism which has its roots in the service which goes with the sale of equipment. While there may be little manufacturing contact in the making of such diverse things as filter presses, agitators, furnaces, evaporators, stills, containers, pumps, temperature and pressure recording devices, etc., a common market place and a coordinated use in a single plant of the various devices made, spell a unity of interest in merchandising that impel organization if the benefits of co-operation to producer and consumer are to be attained.

Aside from several similar organizations in chemical manufacture, this new association has a precedent in British chemical industry, which has done constructive work in standardizing the simpler elements of plant equipment. Under American trade conditions and with Government sanction, the trade association plays an important part in the machinery of industrial government, for it provides the means whereby a common service is provided to all in the same field, which would be impossible without this agency.

The potential membership of the Chemical Equipment Association is of such volume as will give this new trade association first rank among similar organizations in chemical industry, if affiliation is general. That this is a reasonable eventuality is indicated by the numerous prominent concerns which participated in its formation and which have allied themselves with it during the first six months of its existence. To introduce effectively into a branch of chemical industry unity of action along lines of common interest an embracing membership is essential; this the executive staff of the Chemical Equipment Association is now seeking to obtain. All manufacturers of production equipment and accessories used in chemical industry are urged to communicate with Pearce D. Schenck, The Duriron Co., Inc., Dayton, Ohio, who is president of the Chemical Equipment Association.

ALPHA CHI SIGMA, the secret professional society of chemists, has about 35 student chapters in as many educational institutions providing professional instruction in chemistry, and graduates about 400-500 men a year. As with all college fraternities interest of the members wanes after graduation and scattering over the country and the attainment of that maturity which appreciates that every time of life has its corresponding engrossing activity. The general thought now being given to the formation of a professional economic organization of chemically educated men has encouraged the politicians of this secret society, who also are active in the councils of the American Chemical Society, to extend their flourishing undergraduate activities to the graduates in industry in a way to make of their fraternity a secret professional society within the all-embracing educational organization, for which development conditions are favorable.

Graduate members of this college secret society number about 5,000 men who embrace the controlling group of the American Chemical Society. CHEMICAL AGE before has called attention to this anomaly in chemistry of secret professional organization and has explained it by the fact that when a natural, desirable activity is discouraged and condemned by the few in control of government the exercise will be sought *sub rosa* and comes out openly with the courage of numbers. When 5,000 men in chemistry will have perfected a secret professional organization fed by an annual accretion of 400-500 men, the 20,000 barbarians outside the pale must be satisfied with such concessions to their aspirations as are handed down by the group in control of the educational society and of the inner secret professional organization.

To the element in the American Chemical Society intent on the prosecution of this enterprise, we respectfully commend the perusal of Paul's Epistle to the Corinthians in praise of charity. For those not having handy this Treatise we quote in part: "When I was a child, I spoke as a child, I understood as a child, I thought as a child; but when I became a man, I put away childish things."

* * *

WE are all familiar with Barnum's dictum about the propagation of the gullible. The successful quack is the most intelligent, for his endowment enables him to enlarge the scope of his operations which extend in chemistry from the street-corner sale of nostrums to the sale of stock in shady corporations sponsored by chemists. We do not be-little popular education, but we do question the soundness of thought of those who hold themselves out as leaders in chemistry that a journal of popular chemistry primarily is necessary to protect the public from the machinations of charlatans.

The people who read popular journals of electricity, matrimony, radio, salacious stories, mechanics and invention are thus segregated to provide a fertile field for fakirs. To prevent such prostitution of the clientele, the journal must be sponsored by the American Chemical Society which will inaugurate it when the membership provides the funds and is sold on the idea that this is the proper way to protect the public against quackery in chemistry. We are convinced that certain publications of great popular circulation are [illegible] to the degree of danger to the public welfare.

This laudable end will be attained, with infinitely greater ease and with the display of judgment of corresponding proportions, by the exposé of tricksters and the inculcation of ethical standards among chemical practitioners, by the professional economic organization of chemists. The argument of education as a panacea for all evils often is overworked by those who, on the one hand, do not discriminate between intellect and morals and who, on the other, would magnify their office to increase their power. This particular subject is an example.

What is needed is not education of the people so much as control of those who would prey upon the people, which plainly is a function of the strictly economic society of chemists.

* * *

THE American Chemical Society can render no greater service to American Chemistry than for its handful of administrative, controlling members to recommend segregation of ability and standardization of capacity in the practice of chemistry in an affiliated organization of strictly economic functions as regards the material welfare of its membership. To this goal the obsession of one big union of everybody interested in chemistry and dominated by a small, self-perpetuating group eventually must give way.

Encouraging local sections to help men to get jobs is no answer, but a sop to the natural aspiration of the educated man in industry to dignify his calling by the stabilization of conditions that affect material welfare in that calling. To say that the American Medical Association, combining scientific, educational and economic service to the physician, is the ideal of the executive group in the American Chemical Society, is to confuse the respective social positions of the physician and chemist and to admit an egregious aberration in so far as the welfare of the latter is concerned. Physicians serve the people directly: chemists are employes of corporations.

Corporations want cheap, abundant and capable service. In their encouragement of the creation of that abundance which will insure capacity and cheapness, it is business-like for them to promote and influence the policies of an organization designed for this purpose. The chemist's commodity is service which he seeks to sell, under conditions over which he has no more control than an unweaned babe, to buyers who resort in their business to every instrumentality of organization.

Where would you, as a chemist-member of a great, highly specialized group, look to find your basic, bread-and-butter interests served most effectively: In an organization devoted to encouragement of the wholesale production of cheap, chemical help; or in an organization devoted to the control of conditions in industry that such activity creates? CHEMICAL AGE is urged by prominent teachers and chemists to discuss economic conditions in American Chemistry, for "these discussions certainly are illuminating" and "point the way to establishing the professional status of the chemist."

Chemical Industries Exposition

Constitution and By-Laws

THE exhibitors who have made possible the annual chemical exposition for the past eight years, in particular those who exhibited at the show of 1922 and who express varying degrees of dissatisfaction, now have an opportunity to demonstrate their capacity to do what a considerable number believe should be done, viz., to conduct the Chemical Exposition on a cooperative basis by an organization of the exhibitors.

We are in receipt from Adriaan Nagelvoort, Chemists' Bldg., No. 52 East 41st Street, New York, of the Constitution and By Laws of the Chemical Industries Exposition and floor plans of Madison Square Garden and 69th Regiment Armory, New York City, who announces his readiness to book space and his determination to hold September 17-22, 1922 in these structures the Chemical Industries Exposition, as the cooperative enterprise of the exhibitors themselves.

Many believe that the Chemical Exposition should be the enterprise of the industry itself as represented by the exhibitors after the manner of numerous expositions as the Textile, Silk, Ice Cream and Automobile expositions. The time now is here to indicate whether the chemical industry and affiliated lines shall conduct its own exposition on a cooperative basis, or be the patrons of the International Exposition Co. as heretofore. In the following Constitution and By-Laws, the form of government of such cooperative enterprise is set forth.

Name and Objects

The name of this corporation shall be The Chemical Industries Exposition.

The purposes for which this corporation is formed are the following, to wit: To promote in all lawful ways the commercial interests of its members and to secure the advantages to be obtained by mutual cooperation in the organization and maintenance of periodical exhibitions illustrative of progress in the science, art and business of chemistry, in the city of New York or in such other places as may be desired.

Membership

Any individual, a citizen of the United States, or any firm or corporation doing business within the United States, or any representative thereof, shall be eligible to membership, subject to such rules and regulations as may be promulgated by the Board of Directors.

Board of Directors

Section 1. The Board of Directors shall consist of not less than 5 nor more than 15 individuals who shall be either individual members or representatives of corporations or firms who are members. Members of the Board of Directors shall consist of the Chairmen of section committees elected as hereinafter provided, the President and Vice-President ex-officio, and Directors at large not to exceed six in number chosen by the Board of Directors itself.

The Board of Directors shall have general charge, management and control of the affairs, funds and property of the corporation, subject to the Constitution and By-Laws. They shall have the power to appoint such standing committees as they may deem necessary and to abolish the same. They shall have the power to employ such person or persons as they deem best to carry on the work of the corporation.

Section 2. Meetings of the Board. Meetings may be held at the call of the President or at the request in writing to the secretary, signed by at least one-third of the members of the Board. A majority of the members of the Board shall constitute a quorum.

Officers

Section 1. The officers of the corporation shall be a President, a Vice-President and General Manager, a Secretary, and a Treasurer, who shall be elected annually by the Board of Directors. The offices of Secretary and Treasurer may be held by the same person.

Section 2. The President shall preside at all meetings of the corporation and of the Board of Directors. He shall be a member ex-officio of all committees and shall perform such duties as are necessarily incident to his office. He shall have power to appoint special committees and prescribe their duties.

In the absence or disability of the President, his duties shall be performed by the Vice-President and General Manager. The Vice-President and General Manager shall be a member ex-officio of all committees.

Section 3. The Secretary shall keep a record of the proceedings of the corporation and of the Board of Directors and all matters of which a record shall be deemed advisable by the corporation or by said Board. The records of the Secretary shall at all reasonable times be open to the inspection of the Board of Directors. It shall be the duty of the Secretary to notify members of their election, to keep the roll of the members of the corporation, to issue notices of all meetings of the corporation, and to conduct the correspondence.

Section 4. The Treasurer shall keep an account of all moneys received and expended for the use of the corporation and shall make all disbursements. He shall deposit all sums received in a bank or trust company approved by the President or Vice-President in the name of the corporation and shall give bond in amount and with surety satisfactory to the President or Vice-President, the expense of such bond to be borne by the corporation. He shall render a statement of the accounts whenever requested by and to the Board of Directors. His accounts shall be annually audited by the Audit Committee. In case of absence or disability of the Treasurer, the President or Vice-President may appoint a Treasurer pro tempore.

Committees

The Board of Directors shall appoint annually an Auditing Committee, a Membership Committee, an Exhibits Committee, and committees on Raw Materials, Equipment, Manufactured Products, Distribution and Education, and any other standing committees which in its discretion the Board may think necessary.

Election of Officers

All officers of the Corporation shall be elected annually by the Board of Directors and shall hold office for one year and until their successors shall have been appointed and shall have accepted office. All vacancies in office shall be filled by the Board of Directors.

Admission of Members

The signing of contract for space in the Chemical Industries Exposition conducted by this corporation shall constitute the individual, firm, corporation or association a member of this corporation, subject to the terms of said contract and to the provisions of the Constitution and By-Laws of this corporation and to the rules and regulations promulgated by its Board of Directors.

Organization of Sections

Section 1. The Board of Directors shall have power to divide the chemical industry and its allied industries into as many groups or sections as it may deem necessary for the purpose of assembling the members of the corporation into groups or sections of like or similar interests.

Section 2. Sections shall be represented by a Section Committee of three members elected by and from the membership of each designated section. All members admitted to the corporation shall be required to designate upon admission into which section such member desires to be assigned, and such members thereupon shall be so assigned.

Section 3. Each section may adopt its own rules and regulations, provided such are not inconsistent with the Constitution and By-Laws of this corporation.

Section 4. Each section shall have jurisdiction over all matters dealing with its particular branch of the chemical or allied industries, subject to the approval of the Board of Directors.

Section 5. Each section shall elect annually its section committee, or at the time of any special meeting of the corporation called for this purpose. Section committees shall have power to elect their own chairman and to fill the vacancies. Each chairman of a section committee shall be *ipso facto* a member of the Board of Directors. No one person shall be a chairman of more than one section committee.

Order of Business

The order of business at all meetings of the Association shall be as follows: 1. The call of the meeting; 2. The reading of the minutes; 3. Report of the President; 4. Report of the Treasurer; 5. Report of the Secretary; 6. Reports of Committees; 7. Communications; 8. Election of officers; 9. Unfinished business; 10. New Business.

Annual Contribution and Distribution of Funds

No entrance fees shall be charged. Initial payment for space in The Chemical Industries Exposition by an individual, firm, corporation or association designated by the Board of Directors as eligible for membership shall constitute such individual, firm, corporation or association a member of this corporation, subject to such rules and regulations as may be incorporated in the contract for space in the Chemical Industries Exposition, signed by this Corporation and the member-exhibitor.

All surplus funds, as ascertained and reported by the Auditing Committee, may be disposed of as in the judgment of the Board of Directors will be most beneficial to the interests of this corporation.

Expulsions or Suspensions

Any member guilty of conduct injurious to the good order, welfare, interest or character of the corporation may be expelled or suspended by the Board of Directors in its discretion, after hearing.

Quorum

A quorum at any annual or special meeting of the corporation shall be one third of its membership in person or by proxy. The presiding officer may adjourn any meeting for a period not longer than 20 days.

Amendments

The Constitution and By-Laws may be amended at any meeting of the corporation by a vote of two-thirds of the members present in person or by proxy, provided a copy of the proposed amendment or the substance thereof shall have been given in the notice calling the meeting. The Board of Directors may amend the Constitution and By-Laws at any meeting by a vote of two-thirds of the members present subject to ratification at the next succeeding meeting of the corporation.

Constructive Criticism

VICTOR G. BLOEDE, Ch.E.
Carroll Station, Baltimore, Md.

September 28, 1922.

Editor, CHEMICAL AGE.

Permit me to say that I think that the improvement of the character of the Chemical Exposition is a vital one if this valuable work is to be continued or made the permanent success it should be.

The first exposition held, considering the difficulties and the novelty of the undertaking, was in my opinion a very promising one. Although necessarily somewhat crude and incomplete, it seemed to me to carry the nucleus for a development of later expositions worthy of this great industry.

It seems to me that the great opportunity presented by such an exposition has not been properly developed and that instead of an improvement, there has been from year to year, since the first exposition, a steady deterioration in the character as well as the extent of the exhibit, the last exposition in my opinion being by far the poorest and least interesting from a scientific point of view of any of its predecessors.

I am quite aware that to produce a worthy exposition of the great chemical industry is a gigantic task, but it will certainly not be developed upon the lines on which this work is now being conducted.

Even considered as a purely commercial exposition, the 1922 was in my opinion neither an interesting nor progressive one, and I sincerely hope that so worthy an idea and so fraught with such great possibilities will in future be carried out in a more worthy and interesting manner, toward which end I feel sure all of those interested in chemical industry would extend their co-operation.

Yours very truly,

Victor G. Bloede.

Dr. S. W. Stratton, director, Bureau of Standards, Department of Commerce, will accept the presidency of the Massachusetts Institute of Technology. As to the resignation of Dr. Stratton from Government service, Secretary Hoover states:

"The loss of Dr. Stratton as head of the Bureau of Standards is a real national loss. He has built up that service from a bureau devoted to scientific determination of weights and measures to a great physical laboratory co-operating with American industry and commerce in the solution of many problems of enormous importance which the commercial laboratories of the country from lack of equipment and personnel have been unable to undertake. While the Massachusetts Institute of Technology is to be congratulated on securing Dr. Stratton, one cannot overlook the fact that the desperately poor pay which our Government gives to great experts makes it impossible for us to retain men capable of performing the great responsibilities which are placed upon them."

Copper and Copper Alloys in the Chemical and Allied Industries

By Wilkinson Stark, Chemical Engineer

NEARLY all equipment for the manufacture of the various chemicals is made of one of the metals or alloys of several metals. Upon the resistance of these utensils to oxidation, corrosion and erosion depends the life of the equipment and the purity of the product. In its larger sense corrosion is one of the most important subjects before the engineering world today. It is the cause of the deterioration and ultimate destruction of all things made by man.

The dearth of collected and reliable information on this important subject is the cause of the intensive research now being given to it. There is an economic loss to industry whenever an unsuitable metal is used in fabrication, and it is not an uncommon occurrence for a manufacturer to order equipment that is totally unsuited to his purpose with all the attendant evils that such practice entails. A great deal of data has been published from time to time, but this never has been collected and tabulated so as to be available. A great deal is known on the subject by the technical advisors of chemical manufacturers and manufacturers of chemical equipment, but such information usually applies to their particular product or products, and no one company covers the wide field of chemical manufacture in which copper is the essential structural material of the equipment used.

The object of this series of papers is (1) to point out the importance to the chemical and metal industries of research, physical and chemical, in the field of copper utilization, and, (2) by examples of the uses of copper and copper alloys in the chemical and related industries, to indicate a wider field of usefulness for this metal.

"Copper, brass and bronze have been held from time immemorial in high esteem wherever strength, easy-working qualities and resistance to corrosion are essential. Within a comparatively few years the appearance of cheaper and inferior metals has resulted in their use through a false conception of economy based only on a lower first cost. Unfortunately there has been little effort on the part of copper and brass producers and manufacturers to withstand this invasion.

"This situation began before the World War and developed rapidly during hostilities on account of the scarcity of the non-ferrous metals and the absolute necessity of using other materials. Ingenious advertising and aggressive promotion have been weighty factors in this development. Claims have been made that many of the ferrous alloys are distinctly superior to the non-ferrous in endurance, notwithstanding the consensus of competent technical opinion to the contrary. There has been nothing adduced to substantiate these claims, either in theory or practice, and they rest not on the dictum of engineers, but on clever advertising."†

Historical

Copper has been known since the earliest times, its use as the alloy bronze, made doubtless by smelting copper and tin bearing minerals, having been common before the discovery of iron. Agricola, in his *De Re Metallica,* as translated by Herbert Hoover, states that copper was reduced from ore by smelting prior to recorded civilization and that bronze was made prior to 3500 B. C. The metal is said to have derived its name from the Island of Cyprus, from whence the Romans obtained their supplies. The name given to copper at this period of history was Cyprium, which later became Cuprum, and from which our word copper is derived.

The use of bronze as preceding the use of iron is referred to by Lucretius and other ancient writers, and is proven by modern research. Though once a subject of controversy, it is now generally admitted that a bronze age succeeded a stone age and preceded an iron age. In all cases the strata lying over the stone tools and utensils contain bronze implements and the succeeding strata contain the iron utensils.

The bronze age is generally supposed to have begun about 3000 B. C. It is a remarkable fact that, like the proportions of a ship, as mentioned in the Bible, which are fundamentally correct today, so, too, the proportions of copper to tin in the ancient bronzes are the same as are in use today. Analyses of ancient sculpture and coins have a content of approximately 90 per cent. copper and 10 per cent. tin. The first recorded description of any metallurgical work is contained in Homer's Iliad, supposed to have been written about 1200 B. C.

Courtesy of Metropolitan Museum of Art, New York City.

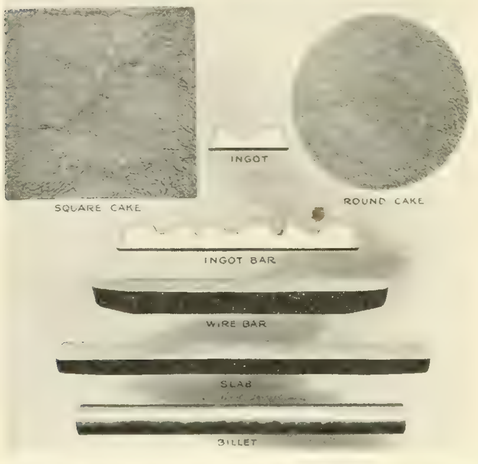
Bronze utensils wrought in the 6th Century B. C. Discovered in a tomb near Monteleone, Umbria, Italy, in 1902. Still in good state of preservation.

---

*The present article is the first of three under the general title, "Copper and Copper Alloys in the Chemical and Allied Industries." Following this brief introductory consideration of the history, metallurgy and economic position of copper, will appear articles on the (2) uses of brass and copper in the building, electrical and chemical industries, and on the (3) uses of bronze and its resistance to corrosion.—Wilkinson Stark.

† *The Metal Industry,* Nov., 1921.

The Romans were the first makers of brass. Although they were unacquainted with the essential constituent, zinc, yet they had devised a means of producing brass by the melting of copper with a zinc ore (calamine), which yielded a yellow alloy of a more lustrous tint than bronze. Brass thus was made for the first time during the reign of the Emperor Augustus (20 B. C.-14 A. D.), and a coin of that period contains 17.31 per cent. zinc.



Shapes Into Which Electrolytic Copper Is Cast for Various Purposes.

Metallurgical

It would be manifestly impossible to go into details regarding the smelting and refining of copper in an article so brief. It is intended, therefore, to mention only the fundamentals of the process. The details of the treatment of the ores vary according to the nature of the ore, and for the purpose of simplicity we will describe the methods prevailing at the Butte, Mont., mines, in which the copper ore occurs principally in the form of the sulphide and with a copper-content of 2-3 per cent.

The copper ores are first enriched by mechanical concentration. This is accomplished by taking advantage of the difference in gravity between the copper-bearing ore and the useless material. Thus 3 per cent. of the copper in the ore becomes 8 per cent. in the concentrated product.

The ore is then reduced to particles of three-eighths of an inch in diameter or less and is roasted to remove 80 per cent. of the sulphur. It is then smelted in reverberatory furnaces which produce "matte," which assays about 40 per cent. copper. The "matte" is treated in converters, whereby the sulphur is volatilized and the iron is slagged off, yielding what is known as "blister copper," so called on account of the blistery appearance of the surface of the pig, due to the gases, chiefly SO_2, contained in the copper. This blister copper is not sufficiently pure for the industries; it also contains the precious metals, gold and silver, of the original ore, and therefore must be refined. Because of the silver and gold contents of the blister copper, and also to the exceedingly pure grade of copper that it produces (99.98 per cent.), the electrolytic process of refining is today generally used. It is not economic to refine blister copper at the smelter, and so the large electrolytic refineries are located on the Atlantic seaboard to facilitate shipments abroad.

Electrolytic Copper Refining

Commercial electrolytic copper refining did not come into use until about 1860, and then batteries were used as a source of electric current for carrying on the electrolysis. The electric dynamo did not come into use until 1866. Prior to this date there was no demand for copper of high electric conductivity for the reason that the electrical age may be stated as to have begun about 1875 with the invention of the telephone, followed by the incandescent lamp, the arc lamp and the electric railroad.

It is obvious that gold and silver could not be satisfactorily parted from copper by the smelting method, and so about 1880 we find the advent of the electrolytic method of copper refining, which development has gone hand in hand with the development of the electrical industry. Modern electrical development would be impossible without large quantities of pure copper produced cheaply.

The theory of electrolytic refining of copper is simple. If in an electrolyte of suitable composition are placed two copper sheets connected to the terminals of an electric generator, and a direct current of suitable voltage and intensity is passed through, the current will enter the anode, or positive pole, pass through the solution to the cathode, or negative pole, dissolving copper from the anode and depositing an equivalent quantity of copper on the cathode. The current dissolves copper from the impure anode and deposits pure copper upon the cathode, the impurities of the anode either dissolving in the electrolyte or not dissolving and settling at the bottom of the tank as "slimes." Among the latter are silver, gold, platinum and palladium.

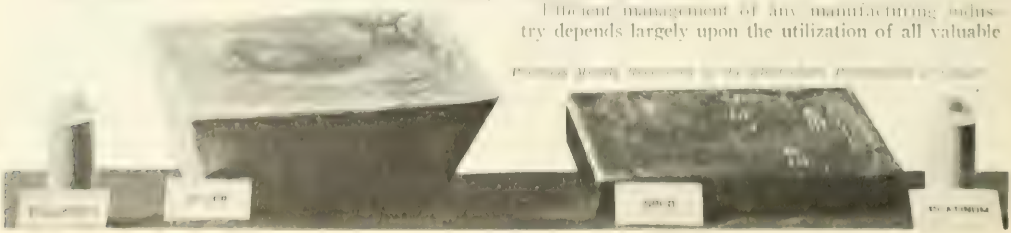
Recovery of By-Products

In the Butte ores silver occurs to the extent of about 2 ounces per ton of ore smelted; gold occurs to the value of about 15c. per ton. Platinum and palladium occur to an indefinitely smaller extent, but the tonnage handled is so enormous that the recovery of these metals is a very important factor in copper refining. These quantities have accumulated in the "slimes" to the extent of 13,000 ounces of silver and 75 ounces of gold, value, $1,550, per ton of "slimes."

It is estimated that today 80 per cent. of the silver production and 15 per cent. of the gold production of the world are recovered from the refining of copper, lead, nickel and cobalt.

Efficient management of any manufacturing industry depends largely upon the utilization of all valuable

Precious Metals Recovered by the Electrolytic Refining of Copper



by-products. This is the case with most smelters using sulphide ores. The sulphur dioxide produced in roasting the ores is converted into sulphuric acid where there is a market for the disposal of this product or where the smelters are in proximity to phosphate mines, where it is used for the manufacture of acid phosphate required in fertilizers. The production of 50° Bé. sulphuric acid from copper and zinc smelters in the United States during 1917 amounted to 1,683,623 short tons of a total production of 5,967,551 tons of like strength for the same period.*

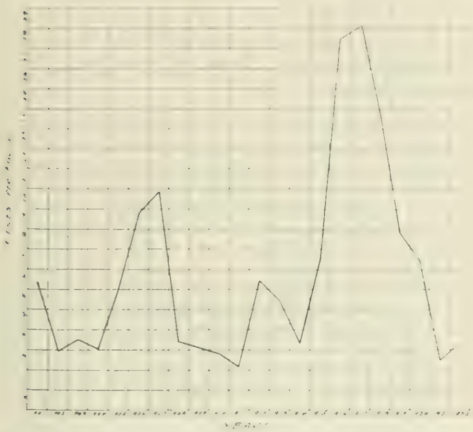


Chart of N. Y. Prices of Electrolytic Copper, 1901 *to Aug.,* 1922*, Incl.**
Note: Government prices fixed at 23½c. per lb. effective from Sept. 21, 1917; 26c. per lb. effective from July 2, 1918. Government regulation ceased Dec. 18, 1918.

Copper Production

Accompanying data of the world's production of copper indicate that the increase has been fairly steady and consistent over a period of 32 years, and that the increase of production during the World War was not phenomenal, although copper is one of the essentials in the manufacture of munitions and other fundamentals of warfare. This partly is to be accounted for by the fact that a great many men were withdrawn from the production of even such a necessary product, and partly by the diminished use of copper in peacetime pursuits under the compulsion of its requirements for war activities.

World's production of copper, 1886-1918 incl. Long tons.*

Year	Tons	Year	Tons	Year	Tons
1886	217,086	1897	405,831	1908	744,240
1887	223,798	1898	429,379	1909	836,870
1888	258,026	1899	463,693	1910	861,109
1889	259,837	1900	486,600	1911	877,830
1890	269,096	1901	517,865	1912	1,006,744
1891	282,713	1902	548,604	1913	984,299
1892	314,509	1903	586,143	1914	899,514
1893	304,943	1904	649,300	1915	1,038,400
1894	315,619	1905	689,784	1916	1,336,500
1895	332,181	1906	712,934	1917	1,405,000
1896	377,534	1907	709,730	1918	1,400,000

United States production of blister copper from ore mined in U. S., 1912-1920 inclusive. Short tons.†

Year	Tons	Year	Tons	Year	Tons
1912	620 757	1915	712,126	1918	968,687
1913	614,255	1916	971,123	1919	604,642
1914	579,133	1917	961,016	1920	635,248

No copper deposits of large extent and rich content have been discovered in recent years. Most of the increase in output is due almost entirely to improved methods in working low-grade ores and in reworking the discarded portions of the ore which previously had been mined but which could not be worked profitably before improved methods of treatment had come into general use. Such demands as may be made in the future probably will have to be met by still greater improvements in the treatment of low-grade ores, rather than by the discovery of new deposits.

Uses of Copper

It has been estimated that the electrical industry consumes from 60 to 70 per cent. of the new copper produced. Next in order come distillation equipment, shipbuilding, making of plate, the bronze and brass industries and the chemical industry. It further has been estimated, July, 1914, that the telephone and telegraph systems of the United States account for 734,000,000 lbs. of copper, and the same industries for the world account for 1,204,000,000 lbs. In the telephone circuit established between New York and San Francisco there are two complete metallic circuits utilizing 5,900,000 lbs. of copper. Assuming a figure of 15,000 lbs. of copper per mile for all purposes and 45,000 miles of street railway in the United States, the street railways have in use 675,000,000 lbs. of copper in equipment of various kinds.

The New York Central and the New York, New Haven and Hartford Railroads, in their suburban service electrification contiguous to New York City, use collectively 13,800,000 lbs. of copper for all purposes. This figure is on a basis of about 800 miles of single-track road, or approximately 17,250 lbs. of copper per mile.

Electrification of the whole steam railroad system would require 4,312,500,000 lbs. of copper. It is hardly probable that this ever will come to pass, but it is not at all unlikely that half of this total mileage, in a generation or so, will be electrified. This will eventuate largely from water-power development and perfection in the means of electrical transmission. Even where coal is used as a source of power the operating efficiency of an electric road is greater than that of a steam railroad, to say nothing of other advantages in favor of an electrically propelled system.

The total consumption of copper in the building industry in the United States in 1922 is estimated at 150,000,000 lbs., comprising copper, brass and bronze in the form of sheets, piping, hardware, lighting fixtures, wire, etc. This is an increase of 100,000,000 lbs. compared with 1921, of 96,000,000 lbs. compared with 1920, and of 73,000,000 lbs. compared with 1919, in which years the amount of copper used in the building industry varied between 4 and 6 per cent. of the total copper consumption of the United States. The building industry's current requirements of copper are apportioned as follows: 118,000,000 lbs. in roofing and sheet metal work; 17,000,000 lbs. in plumbing; 11,000,000 lbs. for lighting fixtures, etc.; 4,000,000 lbs. in hardware.

The potential market for copper and brass in the building industry on the basis of this year's construction, is estimated at 650,000,000 pounds. Other industries consuming tremendous quantities of copper and copper alloys are the automobile industry, boat and ship building, heating and cooking devices, coinage and ammunition.

---

*Figures supplied by the U. S. Geological Survey. As regards sulphuric acid production, the figures include 60 and 66° Bé. acid reduced to the basis of 50° Bé. acid but [illegible] acid.

†Figures from American Bureau of Metal Statistics.

American Institute of Chemistry

By Norman Ashwell Clark, Ph.D., F.C.I.C.
Department of Chemistry, Iowa State College

THE desire for an organization which would hold together the chemists of the country and would define the status of the chemical profession has been evident for a considerable length of time to any reader of the scientific press. During the war period there was a general recognition on the part of the public of the necessity of the chemist in modern warfare. Since then there has been cultivation of popular appreciation of his great part in civilization. To thousands in Canada there came for the first time the realization that there was a difference between the druggist and the chemist.

No one denies that the present condition of the chemist is unsatisfactory; the total lack of any criteria as to what constitutes a chemist is a fact too well known to require discussion. The very comprehensiveness and the inclusive character of the American Chemical Society prevent this organization functioning as a closed professional association. With the steadily increasing numbers of men going into industrial and other phases of chemistry, the benefits of a closed association become increasingly apparent.

No Standardized Conditions

The training of men employed in chemical work has varied widely. Because of the necessity of the chemist in the war, large numbers who knew something of the rudiments of chemistry and were familiar with the manipulation of apparatus were able to take positions in the testing laboratories of manufacturing firms. Frequently these men were successful and acquired valuable experience along the lines in which they were working. With the passing of the demand for war work and the slackening of industry, the need for their employment was removed, and they were faced with the difficulty of finding a buyer for the experience gained.

Still greater was the difficulty for the manufacturer who required expert knowledge; the question whether a prospective employee had the fundamental training necessary to cope with new problems was frequently unanswered or answered with embarrassment to all concerned. There was no recognized standard and no clearing house for chemists. The benefit of a professional organization to the individual chemist clearly is indicated.

Precedents

The advantages of a closed society in the raising of the status of a profession is exemplified in the medical associations of this country and of England. To anyone familiar with the books describing the conditions of a hundred or even fifty years ago, the difference in the prestige of the medical practitioner and his place in the mind of the people is remarkable. A large part of this undoubtedly is due to the work of the medical associations and to the care exercised in admitting men to the ranks of the physicians.

In our own profession we have an example in the work of the Institute of Chemistry of Great Britain. The letters F. I. C. or A. I. C. stand for work accomplished. They are recognized throughout the world as carrying as much if not more weight than a university degree, for they stand for principles which have been put into practice. Still nearer home we have the lately constituted Canadian Institute of Chemistry, which follows closely on the lines of the earlier English organization.

Canadian Institute of Chemistry

The idea of a Canadian Institute of Chemistry was evolved by chemists during meetings of the Society of Chemical Industry. The need of a purely professional organization to deal with questions applying to chemists only had been felt for some time. At the annual meeting of the Canadian Section of the Society of Chemical Industry the question of an Association of Canadian Chemists was brought up by Professor Parker, of the University of Manitoba, with the result that a chemists' organization committee was appointed and the first annual meeting of the Institute held in May, 1920, at Toronto.

It is to be noted that this first meeting was held in conjunction with the Society of Chemical Industry, and that there has been the closest co-operation between the two societies. Legal standing was given to the new institute by incorporation as a Dominion body on August 15, 1921. The institute has three classes of membership, viz.: Fellows, Associates, and Students, and already has members in every province of Canada, as well as in several other countries.

The Canadian Institute of Chemistry maintains an employment bureau; it is the official representative of Canada on the board of the International Chemical Union. The institute aims to be of service to chemists throughout the Dominion in ways not attempted by the Society of Chemical Industry. It is this differentiation of function between the educational society and the economic society that is demanded by the conditions of our time and which thoughtful students of the situation finally were convinced could not be handled satisfactorily in a single all-embracing organization.

American Institute of Chemistry

The usefulness of a similar institute of chemistry in the United States is evident. It should supplement the work of the American Chemical Society and should not conflict with it any more than the Canadian Institute of Chemistry conflicts with the Society of Chemical Industry. It could do much to obtain for the chemist the recognition he should have from the general public, and also could arrange for recognition for the individual chemist who, without university degrees, has worked in some particular field of chemistry and has high standing among those who know his grasp of the subject. Such a society should tend also to promote fellowship between chemists of this country and those of Canada and Great Britain—an ideal well worth the attainment. These results would not all be accomplished in a day by the American Institute of Chemistry, but assuredly the organization would be a step in the right direction.

The Salesmen's Association of the American Chemical Industry met at Hotel Commodore, New York City, Sept. 12, and elected the following officers: President, John W. Boyer, Mathieson Alkali Works, Inc.; vice-presidents, F. M. Fargo, Jr., Calco Chemical Co.; Edw. Van Berlo, Wilckes-Martin-Wilckes Co.; Edgar M. Queeny, Monsanto Chemical Works; secretaries, J. D. Lowery, Kalbfleisch Corp.; George J. Short, Wilckes-Martin-Wilckes Co.

Standardization from the Consumer's Point of View

By N. F. Harriman

Engineer-Physicist, U. S. Bureau of Standards; Technical Secretary, Federal Specifications Board

IN recent years attention has been concentrated upon the material and mechanical side of production and distribution in industry. Physics and chemistry have revealed the secrets of raw materials, and the modern manufacturer can determine the most suitable material and the most economical method of treating it to obtain the desired results.*

One of the most modern aids to industry is standardization, which is now recognized as being of the greatest importance to both producer and consumer. It is sometimes said that the benefits of standardization are mainly to the field of production. This is not the case. They are quite as important to both the field of buying and of selling. In industrial standardization it is the consumer who ultimately is benefitted most, but the immediate benefits are largely to the producer, for it at once simplifies his work and enables him to produce what is required by the consumer cheaply and expeditiously. With lower production costs comes more extended use of the standard article, for it is a law of economics that when costs increase substitutes are used.

Objectors to standardization frequently urge that it would stifle initiative and progress and that the adoption of a standard prevents advance through improvements in the arts of manufacture. Of course this is not the case. A standard should remain standard only until something better is developed, but it should not be changed until justified from all points of view. Any given standard, to achieve its object, must be suitable for the intended use in the majority of cases. The exceptional case requires special consideration, and actual perfection will never be attained. The economies and benefits of standardization as applied to qualities of products and processes of manufacture have been so thoroughly demonstrated within the past few years that they are entirely outside the argumentative field.

Standardization Defined

Standardization, like efficiency, is not an easy term to define; it is not always understood in its true sense and by many is looked upon with doubt and suspicion. The general idea of standards is not new, but its application to science, engineering and industry has been developed within comparatively recent years.

Standardization may be defined as the unification of the methods and practices involved in manufacture, construction and industry, and all lines of endeavor which present the necessity of repetition work. It may be considered under several aspects.

Standardization of nomenclature enables buyer, seller, and manufacturer to use and understand the same language. It is very important that there be acceptable definitions of terms used in specifications and contracts. Purchasing is often done by persons who are quite familiar with the legal side of drawing up contracts, but who are not familiar with the technical details involved. The efficiency of many purchasing officers is lessened by their lack of knowledge of the nature and names of the articles they are intrusted to buy.

Standardization of variety, or simplification, involves the elimination of unnecessary types, shapes, grades and sizes of manufactured articles. Waste in industry is largely due to an over-multiplicity in the number of products, as well as to inefficiency of process. Waste due to idle stocks of material and products through deterioration, obsolescence and capital charges carried is large, especially with large stocks.

Dimensional standardization ensures ready interchangeability of supplies, and the proper interworking of parts which may be manufactured or assembled by different manufacturers.

Standardization of specifications and methods of test puts bids on an easily comparable basis, promotes fairness in trade competition, and ensures the proper grade of material for a given use.

The amount and intensity of standardization work now being done all over the world is surprising. One continually hears of "mass production" and the statement that the extensive introduction of it into industry through standardization is an economic necessity. National industrial and engineering standardizing bodies have been formed and are now functioning in fifteen of the most prominent nations of the world. Germany has been especially active in dimensional standardization, while the efforts of the British and American standardizing bodies have been directed more particularly towards matters concerned with purchases and contracts, such as specifications for materials, performance of machines and devices, methods of test, etc. A notable exception to this general statement is the dimensional standardization work of the automobile industry in this country.

Application of Standardization

From a broad viewpoint, standardization may be applied to materials, methods, products and uses.

Materials—The raw materials used in the manufacture of a product must be of standard and uniform quality, if the process of manufacture and the grade of the product are to be maintained. Sometimes it costs a little more to adhere rigidly to definite standards for raw materials, but the economies effected offset this.

Methods—A product made continuously from standard grade material more readily permits standardization of each step in the process of production. This is attained by the adoption of the one best and most economical method of doing each thing as taught by plant and engineering experience, and making it standard practice.

Product—A standardized product, made to definite specifications, permits an output to the maximum uniformity possible within the limits of manufacturing skill. A uniform product made and sold continuously permits a steady production schedule, building up stocks during periods of low demand and depleting them during periods of high demand. On the unstandardized basis, the only alternative is to follow the "feast and famine" method. The definitely standardized product is manufactured to meet particular wide needs, according to definite specifications, and is constantly tested to ensure its being up to standard grade. The ordinary purchaser is not an expert on quality of supplies, and in many cases the quality can be lowered and he would be none the wiser until the material is put into service.

Uses—One type, shape, grade or size of an article will not meet all the requirements of the consumer, neither is it desirable to have such an extensive variety that the differences are small and meaningless. The ideal condition is to have just enough variety to meet all the real needs with no overlapping. Sound industrial economy demands the elimination of the special or little used product and its substitution by the standard or most widely used and most efficiently produced goods.

---

*Address delivered at Eighth Nat'l Exposition of Chemical Industries, Grand Central Palace, New York, Sept. 11-16, 1922

Standardization of Specifications

Standardization of specifications is the most important phase of the subject from the purchaser's viewpoint. It is the first and most essential step in the economy that arises from the purchase of materials or supplies in large quantities, and is a necessary factor in the improvement of the quality of materials purchased and the adaptation of quality to definite uses. The specification is the common meeting ground for the manufacturer, dealer and user, and it is at once a statement of the user's needs and what the maker is required to supply. Purchase by competitive bids on specifications is preferable to purchase on sample. The latter method implies that each bidder's product must be considered independently, and it is often a very difficult matter to decide between different combinations of quality and price.

The specification should include limiting values for the properties necessary to meet the required service, with proper tolerances. A proper specification is one which enables bidders to know exactly what is desired or required and what procedure the purchaser will follow to satisfy himself that the specification has been complied with. Defective and incomplete specifications, whether due to compromise of quality for temporary economy, or through lack of data, should be replaced by those in which the best magnitude of each property involved is so specified as to predetermine the definite quality best meeting the need. There is a growing appreciation of waste in industry due to the use of defective and improper materials.

To determine the value of any material for a given purpose, its properties must be measured, assuming that the properties upon which its use depends are known and are measureable. The testing of materials may prove a needless waste of time, energy and money unless due consideration is given to the nature of the tests applied, the conditions under which they are made and the interpretation of results. Quality may be determined directly by a service test, indirectly by a test under simulated service conditions, or still less directly by a laboratory test of individual properties upon which the quality is known or assumed to depend. These may vary from a simple visual inspection to an investigation involving laboratory and technical work of the most difficult and precise nature. Friction and controversy between buyer and seller often arise as to the question of facts concern the results of tests, especially when different methods or different equipment are used. Standardized methods of test consider all of these conditions, and are a necessary part of an ideal specification for a material or a manufactured article.

Government Specifications

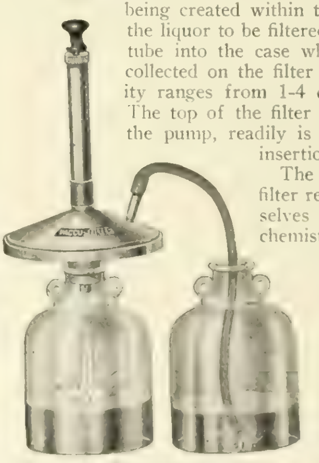
The United States Government is probably the largest purchaser of materials and supplies in the world, and the greatest impetus that could be given to standardization from the purchaser's point of view would be for the Federal Government to adopt standard purchase specifications for the more important materials and supplies purchased by it. This has recently been initiated by the establishment of the Federal Specifications Board, in the office of the Bureau of the Budget, which has brought together the experts of the various departments. As a result specifications representing the best commercial and engineering practice are being selected for the use of all departments and bureaus alike in the purchase of supplies.

The selection and adoption of specifications or standards without due regard to the manufacturing problems involved would be equally as serious as for manufacturers to establish standards without a careful consideration of the needs of the purchaser. In the selection of specifications for Government use, the Federal Specifications Board is co-ordinating these two interests, and the standards adopted will eventually be used for all Government purchases. This procedure will undoubtedly serve as a model to be followed by corporations, municipalities, States and the general public.

With many large corporations, the standardization of purchases, and the resulting simplification of store stock varieties of materials offer a fertile field for economy, and the purchasing officer with a technical knowledge of materials and supplies, together with a knowledge of standardization principles, is best equipped to secure maximum results.

A Handy Filter

A compact portable filter, convenient and of high efficiency within a wide range of usefulness is shown in the accompanying illustration. The circular filter case surmounts the vessel which collects the filtrate, into which projects the suction pipe connected with the vacuum pump above the filter case, whereby a vacuum is created below the close-mesh screen disk, which supports the filter paper within the case. A vacuum being created within the receiving vessel the liquor to be filtered flows through the tube into the case where the residue is collected on the filter paper. The capacity ranges from 1-4 quarts per minute. The top of the filter case, which carries the pump, readily is detachable for the insertion of filter paper.



The Vaccu-Filter

The many uses of this filter readily suggest themselves to the industrial chemist, not only for laboratory work, but for plant tryouts where it is not practicable, owing to the small quantity of liquor to be filtered, to use a plate press. In chemical manufacture, where small quantities of liquor are handled, its usefulness is apparent. All parts are of brass, heavily nickel plated. The filter paper, lying flat, is not exposed to rupture, as is so frequent with the cone filter, whereby the filtrate is ruined. The Vaccu-Filter is made by the Alsop Engineering Co., 157 Water street, New York City.

Dr. Charles R. Downs and John M. Weiss, of the research department, The Barrett Co., have been awarded by the Franklin Institute, the John N. Potts Medal, in consideration of their notable achievement in the scientific and commercial development of the catalytic vapor phase oxidation of benzene to maleic acid and their pioneer work in developing a commercial process for converting aromatic to aliphatic compounds.

The Proposed Butter-Fat Standard

By Hermann C. Lythgoe

Director, Division of Food and Drugs, Massachusetts Department of Public Health

I HAVE read with considerable interest the article entitled "Fiat Butter" on page 38 of July CHEMICAL AGE, and, while on the surface the views there expressed seem correct, there is another point which has not been considered and which may, and probably does, have some bearing upon the question of a fat standard for butter.

I have been engaged during the past twenty-five years, formerly as a chemist, and recently as an executive of the Commonwealth of Massachusetts, in the enforcement of criminal law, during which time I have been impressed often with the fact that a crime without a penality, a standard without a law prohibiting the sale of the article not conforming to the standard, or the right to make regulations with no power to enforce them is of little or no value to the community. Under such conditions the executive can do little except to bluff, and if the bluff is called he is placed in a very embarrassing position. There is no doubt that the Secretary of Agriculture has the right to promulgate standards and to make regulations to secure a proper enforcement of the Food and Drug Act, but nowhere have I been able to find any penalty for violations of these standards or regulations, and I know of no case which has been contested and a conviction secured when the complaint alleged a violation of these standards or regulations. Furthermore, I doubt if these standards or regulations can be properly introduced as evidence in the U. S. Courts to substantiate such complaints.

Shortly after the passage of the U. S. Food and Drug Act a large number of influential but impracticable and, to some extent, uninformed persons, in a laudable attempt to secure uniformity and insure cooperation, endeavored to remodel all the State food laws in order that they might conform with the U. S. laws, and to include in these remodeled laws the adoption by the Law Enforcement Board of the so-called U. S. standards, and to provide a penalty for the sale of articles not conforming to such standards. In general, these changes in State food laws have been valuable, for we had many weak food laws in the various States in 1906.

A bill modeled as above described to replace the efficient food law of Massachusetts in operation since 1882 was for many years a hardy perennial in the Massachusetts Legislature, and in 1916 such a bill was passed notwithstanding the objections of the Massachusetts Department of Public Health specifically to the provision relative to the adoption of the standards. The present Massachusetts law has a guarantee provision which protects the seller of goods in original, unbroken packages wherever they were manufactured, provided he has a proper guarantee from the manufacturer, wholesaler or jobber. This guarantee provision, however, does not protect the retailer after he has broken the package and begins to sell by the pound.

Let us consider the butter sold in Massachusetts, practically all of which is shipped into this State from other States. I found in 1920 that considerable of this butter contained less than 82½ per cent. of fat, which was the standard we were obliged to adopt. I could have prosecuted the retail dealers selling this butter by the pound, but I preferred to deal with the source. In January 17, 1921, I therefore wrote the U. S. Department of Agriculture, asking for co-operation between the departments to straighten out the existing situation and quoted analyses of samples of butter varying from 79.36 to 80.62 per cent. fat, and from 12.50 to 15.86 per cent. water. I received a reply under date of January 29, 1921, that there had been a strong demand on the part of the trade for a reduction of the standard to 80 per cent.; that the department neither reaffirmed the old standard nor adopted the new one, but had advised the butter industry that pending official decision in the matter action would not be taken against butter because of deficiency in butter fat, if the fat content were not less than 80 per cent., or if the moisture content were not more than 16 per cent. A press notice of the department accompanied the letter, stating under a heading, "Water Sold at 90 Cents a Pound," that the federal officials do not recommend seizure when the butter contains as much as 80 per cent. fat and is otherwise in accordance with the law.

About the time I received this reply I discovered that in the revision of our Massachusetts laws, which had gone into effect on January 1, through a technical change in the wording of one section, the butter and a few other standards adopted by this department were automatically revoked. Later in the year a change correcting this situation was made in the statutes, and the Massachusetts Department of Public Health has been obliged to readopt the butter standard of 82½ per cent. fat.

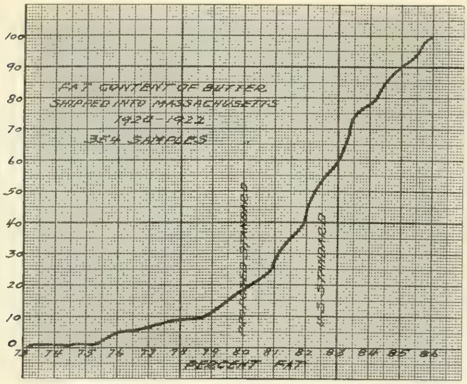
There are two courses of procedure open to the department; either to ignore the standard, thereby casting reflections upon the integrity of the department, or to enforce it and create a butter famine in Massachusetts. The latter procedure was decided upon early this spring, and I believe that it is in part responsible for the action of the butter interests in endeavoring to obtain Congressional action for the establishment of a satisfactory standard for fat in butter.

You need not worry. There will be no increase in water transportation if this bill becomes law, but if Congress enacts a butter standard, whatever the standard may be, State officials can proceed in the United States courts in cases of violation if the Department of Agriculture declines to act. Under the present conditions, State officials can take no action in the United States courts because the standard cannot be enforced.

I do not wish to infer that the Department of Agriculture does not make seizures of adulterated butter; it does, but the seizures are made when the moisture content is sufficiently high to warrant a complaint that the butter is adulterated within the meaning of the definitions of adulteration in the law and not for variance from the standard.

Many of the dairy schools in this country are giving instruction in obtaining an "over-run" of butter. While the Department of Agriculture may not be directly interested in such instruction, yet it is naturally highly interested in the welfare of the farmer, even though it is endeavoring through the Bureau of Chemistry to protect the public from such "over-run." This anomalous position may account for the working agreement of 80 per cent. fat, and the failure to revoke the standard of 82½ per cent. fat. I believe, however, that a standard of 80 per cent. fat can be lived up to much better than the 82½ per cent. standard, and I believe that such change is desirable.

I have compiled the analyses made during the past



two years of 345 samples of butter. At least half of these samples represented butter which had been in storage for one year, upon which requests were made for extension of time in storage. These samples certainly must have lost some moisture during that time, and it is reasonable to assume that these figures represent the highest fat-content of butter sold in interstate commerce during 1920. I have excluded from this list samples above 86 per cent. in fat, which were unsalted butter, and those below 73 per cent. fat.

53.4% of the samples were below 82½% fat.
36.2% of the samples were between 80% and 82½%.
17.2% of the samples were below 80% fat.

In the accompanying summation plot of these figures can be visualized the variation in composition of the butter sold in Massachusetts from the present United States standard of 82.5 per cent. butter-fat and from the proposed standard of 80 per cent. butter-fat.

Acetaldehyde from Acetylene

By Howard W. Matheson

Vice-President, Canadian Electro Products Co.

A CONSIDERABLE number of patents have been secured purporting to disclose methods for the manufacture of acetaldehyde. It has been found, however, that for the most part, these patents disclose processes which are faulty from a commercial point of view. The processes as disclosed in these patents can be admirably carried out under laboratory conditions where only small amounts of acetaldehyde are produced. In carrying out the manufacture commercially, many conditions arise which do not exist in the laboratory, and therefore very considerable deviation is necessary, from the disclosure of the existing patents, in order to arrive at a commercially practical and economical method of manufacture. Moreover, such patents when critically examined are found to disclose only "batch" or discontinuous processes.

There has been propounded as a species of axiom the theory that when using as a catalyst acids containing mercury salts, the concentration of the acid and the working temperature must be varied inversely; that is to say, if a highly concentrated acid is used, the working temperature must be low, and if a greatly dilute acid is used, the working temperature must be high. It has also been stated that the use of dilute acid is disadvantageous, because of the rapid reduction of the mercury salts to the metallic mercury.

According to U. S. Patent Reissue 15,434, it has been found that the manufacture of acetaldehyde can be carried out commercially with great ease, safety and efficiency by using as catalyst a dilute acid containing mercury salts and working at comparatively low temperatures, and atpressures as little above atmospheric as possible. Under these conditions, the formation of aldehyde resin and other undesirable products is for all practical purposes completely avoided, and at the same time, the apparatus is not attacked by the acid, and the mercury compound is resolved only very slowly to metallic mercury compounds is resolved only very slowly to metallic mercury. Furthermore, the metallic mercury settles readily to the bottom of the reaction vessel, where it may be drawn off from time to time, and does not remain in fine particles in suspension throughout the liquid. It has also been found that the production of acetaldehyde may be carried on in a continuous manner if the components of the reaction are replaced as they become used or useless, so as to preserve proper proportions, and that this continuity is not dependent on the acid strength, catalyst, temperature or pressure.

The process in greater detail insofar as the reaction is concerned is as follows: In a suitable vessel, preferably of high silicon iron having a mechanical stirring device, approximately one thousand gallons of 6 per cent dilute sulphuric acid is introduced as an initial charge, together with approximately twenty-five pounds of neutralized or slightly acidulated mercuric oxide. Commercial acetylene gas is passed through the reaction liquid greatly in excess of the amount which can possibly be combined to form acetaldehyde, for example, at the rate of approximately sixty cubic feet per minute. The major portion of the heat of reaction is removed by external cooling. The temperature is preferably maintained between 60° and 65° C. which is well below the temperature of ebullition.

The continuity of the particular or any similar process is preserved by testing the reaction liquor at frequent intervals and adding water, acid or mercuric salt or both, as may be required to maintain the catalyst normal. The outflow of excess acetylene from the apparatus is unrestricted, so that the pressure remains very low and amounts at most to only two pounds, which is incident to the back pressure of the scrubber, as previously stated. The temperature, flow of gas and condition of the catalyst are maintained as nearly uniform as possible and the acetaldehyde forms at a rate which may be considered remarkably rapid, in view of former disclosures. Owing to the temperature of the process, the acetaldehyde is formed in vaporous condition and is entrained by the excess acetylene and carried out of the reaction vessel immediately. The mixed gases pass through a number of condensers and a scrubber, which are arranged in series and which for all practical purposes completely remove the acetaldehyde from the acetylene. It has been found satisfactory to use first, a cold water condenser, and second a brine condenser, having a temperature of −10° to −15° C. The first condenser cools the escaping gases and removes a small portion of the same. The remaining acetaldehyde is largely absorbed by the cold water in the scrubber.

The acetylene is then returned to the supply of the reaction vessel by any suitable apparatus, such as a blower, and in order to render the return of acetylene uniform, a gasometer may be arranged in parallel with the blower, so that acetylene coming from the scrubber in excess of the capacity of the blower will be received in the gasometer, while if the amount of gas issuing from the scrubber is below the capacity of the blower, the previous surplus of gas will be drawn from the gasometer.

Owing partly to the comparatively low temperature maintained in the reaction vessel and the dilution of the acid, and partly to the material of the vessel, it is not attacked to any appreciable extent by the acid, and therefore two essential requirements are met with, namely, the preservation of the vessel and the preservation of the catalyst. Contrary to the opinion expressed in previous patents, the mercuric oxide is not rapidly decomposed in the weak acid solution. Decomposition of the mercuric oxide, it is true, does occur, but only very slowly, and in such manner that the mercury liberated in metallic state largely collects in the bottom of the vessel and does not remain in suspension in the liquid nor interfere with the reaction. A certain further amount of the mercuric oxide is rendered ineffective by the combination with sulphur and phosphorus forming complex organic compounds, and for this reason, it is necessary to clean these out of the reaction vessel from time to time, in order to eliminate the foreign matter.

The acid solution is separated from the solid matter by settling, and is then siphoned off and usually returned to the reaction vessel. As it is obviously impossible to separate any finely divided mercury from the mercury-sulphur and mercury-phosphorus organic compounds, it is necessary to treat the whole mass in order to to recover the mercury in metallic state. The mercury thus recovered is treated preferably by electrolytic means to produce mercuric oxide. The oxide when formed is usually alkaline and is neutralized or slightly acidulated, before being introduced into the reaction vessel.

The loss of sulphuric acid, mercury and acetylene in carrying out the process as above described is very small, and the amount of acetaldehyde produced is almost the theoretical amount. The acetaldehyde collected from the condensers together with the scrubber water is refined by distillation, and the final vapor or gas issuing from the still passed through a scrubber, which will collect any acetaldehyde not previously condensed and separate from it traces of acetylene which may have passed through the still in solution in the acetaldehyde. This scrubber water is collected with the output of the acetaldehyde condensers and scrubber in order that none may be lost, while the acetylene may also be returned to the supply for use in the reaction vessel.

From the foregoing description, it will be seen that the process is continuous in every respect and may be carried out easily and conveniently on a commercial scale. There is practically no loss of the catalyst or of the acetylene, and the apparatus remains undamaged even at the end of considerable periods of time. The large excess of acetylene carries the acetaldehyde out of the reaction liquid as soon as it is formed, so that it does not remain in contact with the acid a sufficient length of time or is subjected to a sufficiently high temperature to form acetaldehyde resin or crotonaldehyde or other undesirable products. The yield of acetaldehyde is large, equalling almost the theoretical amount, and is produced very rapidly.

Nitro-Cellulose Films Condemned

Following the action of the Bureau of Police, Paris, France, prohibiting the use of nitro-cellulose motion picture film in places of public assembly on and after January 1, 1925, the Pacific Coast Association of Fire Chiefs and the International Association of Fire Engineers at their convention in San Francisco in August unanimously adopted the following resolution:

WHEREAS: the nitro-cellulose motion picture film now in general use is of the nature of gun-cotton, and the handling, transportation and storage of the same is therefore a menace to life and property, and

WHEREAS: there is now commonly manufactured in America and in Europe a film of cellulose acetate or slow-burning material rendering the same safe and non-hazardous: it is therefore hereby unanimously

RESOLVED: by the International Association of Fire Engineers that in view of the availability of a safe film the present expensive burden of inspection, regulation and surveillance of motion picture displays placed by the motion picture industry upon public fire and safety departments is unwarranted and indefensible and it is the moral duty of this industry to adopt at once in the production of all new pictures the exclusive use of the slow-burning film and it is further

RESOLVED: that the International Association of Fire Engineers hereby calls upon the Federal, State and municipal governments to take proper steps to prohibit by law the use of the nitro-cellulose motion picture film on and after January 1, 1925

Limitations of Cerium

The study of cerium as an alloying element in steel, conducted at the Ithaca, N. Y., field station of the U. S. Bureau of Mines, in co-operation with the Welsbach Company, has been finished. The attempt to utilize the cerium group of metals, made from by-products of the gas-mantle industry, in alloys other than the pyrophoric alloys, gave only negative results. In aluminum alloys the cerium group of metals had no useful effect either as alloying materials or as scavengers. In steel, the desulphurization effected by the cerium metals was accompanied by the retention in the steel of inclusions due to the cerium metals. The harmful effect of the inclusions overbalanced any good effect due to desulphurization or to the presence of cerium metals as alloying elements. Either plain carbon steel, or various alloy steels to which cerium was added were not improved; usually, especially when heat-treated, they were decidedly poorer than similar steels without cerium.

Collected data showed cerium to have no marked effect as a true alloying element in steel, and to be harmful rather than helpful when used as a scavenger. The conclusion drawn was that, under any condition tried, the cerium group of metals was not useful either in steel or in aluminum, and such data as were available indicated that it would not be useful in other non-ferrous alloys.

Philip DeWolf, formerly of Louis Schlesinger, Inc., is now associated with Sanderson & Porter, 52 William St., New York.

* * *

Dr. Joshua Bernhardt, formerly of the Institute for Government Research, Washington, D. C., is the new sugar expert attached to the U. S. Tariff Commission.

* * *

Charles McKnight, Jr., formerly works manager, Carbon Steel Company, has joined the staff of the development and research department, International Nickel Co., New York City, to undertake development work in connection with alloy steels.

International Relations in Chemistry

A Plea for the Resumption of International Comity in Chemistry

By Dr. W. A. Dyes

Consulting Chemist and Economist; Editor and Publisher, Handbook of the World's Chemical Industry and Trade

NOTABLE among the meetings of the current year of chemists of various nationalities designed to take up the broken threads of scientific intercourse was the meeting at Utrecht, Holland, on June 21-23, where chemists from England, America, Germany, Austria, Czecho-Slovakia, Denmark, Holland, Latvia, Russia and Switzerland assembled for the presentation and discussion of scientific papers. American chemists present were L. M. Dennis, Cornell; Duncan A. MacInnes, Massachusetts Institute of Technology, and W. A. Noyes, University of Illinois.

I mention this meeting because it is an example of co-operation among leaders in chemistry, which should serve as a precedent for our leaders in statecraft and business. The solution of the world problems will progress only to the degree that the various nationalists put themselves in a position to look at affairs from each other's points of view, which is a condition precedent to that general co-operation in which our leaders first must participate. Chemists from nations only recently at war foregathered at Utrecht to promote this common interest in chemistry. The renewal of old friendships and the creation of new ones were with the desire for the speedy restoration of peace-time relations. It is with the spirit of this meeting that I wish to address American chemists in the assurance that they will look at things from the point of view of German chemists, and in which I hope that I will be fortunate enough to look as well at things from a point of view which may express their sense of fairness.

DR. W. A. DYES

Editor and Publisher, Handbook of the World's Chemical Industry and Trade

Two months after Germany's downfall I wrote a long article in *Chemiker Zeitung*, January, 1919, entitled "New Times," using as a motto the words of a German poet, to wit: "New procreative light, be our guide! We do not listen to the cries of our enemies. We do not see the torches of the victor. We expiate in ourselves; the multitude, dazed and unaware, the few, however, frightened by the unvarnished truth." I have been attacked because of the motto and my remarks, but I stand by my convictions, because I believe in the necessity of learning from errors. Slowly the ideas and the foundation of a new Germany are conquering more and more ground, but it takes time in a country where the "Autoritätsglaube" has been shaken in such a terrible manner and the number of "leading personages" is at once small!

Until history has yet set its final judgment on the Franco-German war and the circumstances preliminary to the war and not only the events of 1914 which resulted in the catastrophe over Europe, men of true science and historical comprehension hesitate to allocate responsibility. If history should testify that German scholars have been guilty in defending the soul of their country, the guilt by no means would be confined to 1914, but to the period 1878-1914. Dr. Kenneth C. M. Sills, of Bowdoin College, certainly will admit that if German scholars had not stood behind the front of their fighters after the hell of war had set ablaze the whole of Europe they would have been faint-hearted cowards.

Undoubtedly it is a reproach which is justified, that German scholars during 1878-1914 did not fight against the influence of autocracy, mammonism (partly a result of the receipt of the French indemnity of 1871-1878), and overestimation of the moral values of industrial and commercial progress. Luther, Schiller, Goethe, Arndt and many other German thinkers had been forgotten or too little valued in the country of the "Dichter und Denker" during a period of rapid industrial and commercial development of about 30 years. True science could not carry its full weight and importance at a time, when a young emperor without a manly, developed character (see Bismarck's Memoirs, Vol. III), surrounded by courtiers without backbone, dominated German life and thinking. Many excuses for the military spirit will be found by those who know the geography and history of Germany, France and Russia, the memoirs of the Russian minister Graf Witte and the diplomatic steps of Poincaré in 1914.

The American living in a country without boundaries in the European sense cannot comprehend fully the difficult position of a rapidly growing nation encircled by mighty armed nations like France and Russia. True democracy did not reign in any large European country —that is the reason for the present fate of Europe. Notwithstanding which, I invoke the words of an American patriot and soldier, when I call those countrymen cowards who, during the severest ordeal visited upon nations, had not stood on the side of their country, "right or wrong, my country," and I think Dr. Sills would judge every American in the same way. What has to be regretted and repented is, in the first instance, the small-eyed, narrow-minded comprehension among European scholars generally of European history and European Unionism.

Each country has its standard of culture or "Kultur." Each country has its good and bad qualities, so the individuals have their different standards of culture, of good and bad qualities. To generalize and stamp a profession or group in a nation with the seal of quality or disquality is always dangerous. We all admit the frailties of human kind. It is, therefore, in my opinion a mistake to judge nations or people of an acknowledged position by picking out a few examples. Nothing is so difficult as the psychological understanding of a foreign nation. Germany, at least, should know this.

After such a terrible war it is, of course, difficult to forget and to change one's views or convictions quickly. Too much poison has been printed and imbued even unprejudiced minds. Nevertheless the progress of the world, with all that it implies in human life and struggle, demands that men work together, that leaders of opinion in the respective nations teach the doctrines of our common Master, which, however futile they were to prevent war, should be powerful to heal its wounds.

The editor of CHEMICAL AGE assures me that I am the first German chemist that he knows who publicly and with a frank heart has pleaded for fraternity in the basic science of chemistry. This I am proud to do and hope that my humble example may stir others to speak openly their minds that science which knows no national boundaries may flow without restriction from one country to another in its work of alleviating the ills of the world and of promoting the welfare of mankind.

Current Chemical Patents and Patent Problems

By Lloyd Van Doren, Ph.D.
Consulting Chemist; Patent Attorney, Duell, Warfield & Duell

THE suit of the Government against The Chemical Foundations, Inc., for the return of all patents, applications for patent, trade marks, copyrights, choses in action, and other property transferred to the Foundation by the Alien Property Custodian, was filed in Wilmington, Delaware, September 8th, requiring an answer on the part of the Foundation to the allegations in the bill of complaint within twenty days. The Chemical Foundation, Inc., applied for an extension of time in filing its answer, and has been granted an extension of thirty days; hence it is anticipated that the case will now be called shortly after October 28th.

New Trade Mark Regulations

The amendment to the trade-mark laws proposed by Senator Sutherland and enacted along with the Tariff Bill, is considered by some to open the door for an unfair and unjust repression of trade by unscrupulous individuals securing the registration of a trade-mark which has been applied to a recognized class of merchandise and thereby preventing the importation of such articles or allowing the importation through the exaction of a considerable royalty. The requirements which must be met in order to secure the registration of a trade-mark would seem to preclude such a possibility, inasmuch as the applicant for the registration of trade-mark or trade name must make certain declarations with respect to his use of such trade-mark or trade name. The application is carefully examined with respect to anticipation, and if found to be non-anticipated is then published in the Official Gazette and is open to the filing of an opposition within thirty days after the initial publication.

The grant of a trade-mark or trade name, therefore, is predicated upon its actual prior use in a going business. It would appear, consequently, that it would be extremely difficult for a registration to be secured without such an accompanying feature, and hence it is believed that unless international complications arise growing out of the fact that the amendment refers to "a person domiciled in the United States" the enactment will serve to grant greater protection with those having trade-mark rights.

Patent on Product Defined by Description of Process

According to the practice before the Patent Office, it has been considered for some time that the claiming of a product solely by the process of its manufacture is not proper and that such claims cannot rightly be accepted. This attitude evidences considerable justification, in view of the fact that, where it appears that a product can only be claimed by the steps involved in its manufacture, such claims are of little value in the event that claims for the process itself are deemed to be allowable. Where a product is claimed by the process, it receives protection only as the steps of the process are actually used in its formation; hence when process claims are granted there does not seem to be any added protection gained through the grant of claims for the product defined only by the process. It is interesting to note that in a recent decision of the Commissioner of Patents in *ex parte* Fesenmeir, handed down August 8th, 1922, it is held that the applicant is entitled to claims for a product defined only by the process of its manufacture. In view of the possible interest attending this decision, it is herewith given in full.

> The alleged invention relates to the production of a canned substance containing a mixture of hops and a liquid hermetically sealed in the container. Appellant has been allowed claims for the process by which he produces his product, and is here seeking the allowance of claims for the product defined by the steps of the process by which it is produced.
>
> The rule against allowing claims for a product defined by the steps of the process of producing it is well enough settled, and the objections to the violation of the rule are material and should not be lightly disregarded. Where it is possible to define a product by its characteristics, the practice is clearly settled that this should be done. Where, however, the product is novel and involves invention and can not be defined except by the steps of the process involved in its creation, there are cases holding that such a claim may be allowed, and it has been sustained by a Court.
>
> *In ex parte Painter* (57 O. G., 999; C. D., 1891, 200), the Commissioner stated:
>
> > When the case arises that an article of manufacture is a new thing, a useful thing, and embodies invention, and that article can not be properly defined and discriminated from the prior art otherwise than by reference to the process of producing it, a case is presented which constitutes a proper exception to the rule.
>
> In *ex parte Shneckner* (106 O. G., 765; C. D. 1903, 315) the Commissioner stated:
>
> > It is the general rule that an article of manufacture should not be defined in the claim by the process of making it.
>
> That objections to such a claim have been raised by courts, in the adjudication of patent cases, is clear enough. In the *Hide-Ite Leather Company et al.* v. *Fibre Products Company et al.*, Circuit Court of Appeals of the First Circuit (226 F. R., 34), the court referring to such a claim, stated:
>
> > It is also a well recognized rule that, although a product has defined characteristics by which it may be identified apart from the process, still, if in a claim for the product, it is not so described, but is set forth in the terms of the process, nothing can be held to infringe the claim which is not made by the process.
>
> This holding is based upon the rule of the Supreme Court of the United States in the case of Cochrane et al *v.* Badische Anilin & Soda Fabrik, 111 U. S., 293, in which the court said:
>
> > Every patent for a product or composition of matter must identify it so that it can be recognized aside from the description of the process for making it, or else nothing can be held to infringe the patent which is not made by that process.
>
> Where the product is new and has been defined in this way, claims of such character have been sustained, as were above noted. In the [illegible] *Nail Co.* (19 Fed., 819), a claim for a horseshoe nail made by certain steps recited in the claim was sustained.
>
> In the case of *Oval Wood Dish Co., et al.* v. *Sandy Creek, N. Y., Wood Mfg. Co.* (60 Fed., 285), Judge Coxe, in holding the following claim valid—
>
> > A plate or dish [illegible]
>
> stated:
>
> > [illegible]

In the cases above noted the article or product was novel. This will be seen from the quotation from each one of these adjudicated cases.

Where the product is old, it is not patentable because a new process of producing it has been discovered, nor does a claim for the product become patentable merely by including the steps of the new process. If such a claim is sustained by the court, it is construed as a claim for a novel process, and should, therefore, be drawn in the form of a process claim. In the case of *Societe Fabriques de Produits Chimiques De Thann et De Mulhouse* v. *George Bueders & Co.* (135 R. R., 102), the court held that a patent distinctly for a product produced by a certain process is void if the product has been previously produced by any other process.

Again, in the above noted decision, *Cochrane et al.* v. *Badische Anilin & Soda Fabrik,* the court, referring to the article defined by the process of producing it, stated:

> It was an old article While a new process for producing it was patentable, the product itself could not be patented, even though it was a product made artificially for the first time.

The question presented for review is whether the instant case is one to which the rule against claims of this character should be applied, or whether it is one forming a just exception, one where the product is new and involves inventive concept in its production, and yet can not be defined save by stating the steps necessary to produce it. The only change in the character of the product set forth in the claims, aside from the steps of the process, is that all the essential oils, essences and aromas have been extracted from the hops and disseminated through the liquid. Is this product new?

Appellant urges that it is; that there is a more thorough cooking and rending; a product more concentrated than obtained heretofore, one that is more palatable, and is better flavored by reason of tis having embodied in it all the essential oils, essences, and aromas extracted from the hops and made to permeate the liquid. I am not prepared to dispute this contention. The oils of hops are very volatile, and heating in an open vessel, as disclosed by the British patentee, even at a low temperature, would necessarily drive off much of the volatile fumes of the essences and aromas. An attempt to restore this lost portion by adding beer wort or aromatic oil of hops to replace that lost is more uncertain and in my judgment would not produce the same product obtained by heating to the higher temperature in the sealed receptacle, and thereby extracting substantially all the oils, essences and aromas and preventing their escape and forcing them to be disseminated through the liquid. It would seem there has been produced a novel product.

In defining the characteristics of the product, so that it may be identified, it is not necessary that they be so defined that the general public, by a mere casual inspection, can determine the novel features of the product. It is sufficient that an expert can do this. The article or product may have to be bent, broken, tested chemically, or even destroyed to determine its characteristics, but if these are so set forth that they may be determined in one of these ways it is sufficient.

The applicant has stated he is unable to define his product by any other means than by the steps of the process of producing. The Examiner has suggested no other way, and I am unable to add anything by way of suggestion. It is thought, therefore, that the claims should be allowed in their present form.

Cold Water Paint

A waterproof coating suitable for many exterior surfaces and of general interior application is a well known commodity available in powder form. It comprises an adhesive agent, as finely ground casein, or glue, to which is added hydrated lime, and a filler which may be calcium carbonate, talc, clay, silica, barytes or gypsum, together with any desired coloring matter. Arthur L. Rice, Adams, N. Y., applied for a patent on such a compound and it was issued to his executrix (U. S. Pat. No. 1,423,256). Good results are claimed for a product made up of 15 lbs. of casein, 10 lbs. of hydrated lime and 75 lbs. of filler. These ingredients are thoroughly mixed and marketed as a powder, together with a solution of paraffin wax in a suitable solvent (about 1 lb. of paraffin to 1 gal. of the solvent). This solvent constitutes a waterproofing liquid which, when mixed with the powder, formed into a relatively thin paste with water, constitutes a washable surface coating applicable for many purposes.

Five pounds of the powder yields 1 gallon of the coating to which is added 1 quart of the paraffin solution. At first, the solution does not mix with the water paint but by constant stirring an emulsion is formed which is semi-permanent. This emulsion will retain its physical properties for any ordinary period of paint application, but it is best to stir this paint, like all others, occasionally, as it is being applied. The waterproof water paint after it is applied sets or dries in about two hours, forming a practically waterproof non-absorbent coating which is also fireproof and suitable for either outside or inside use on wood, brick, stone, cement, and other porous surfaces, wall board, paper and other absorbent surfaces, galvanized and other metal, etc.

A Black Pigment from Spent Fullers' Earth

Fullers' earth is of general use in the decolorizing of fats and oils from which, after agitation, it is separated by means of the filter press. The press-cake thus obtained is a waste product. Extraction of the cake with volatile solvents, while technically practicable, is not of commercial interest because of cost and inferiority of the extracted product. Karl B. Lamb, of the American Cotton Oil Co., proposes the utilization of this waste press-cake for the manufacture of a black composite pigment which his investigation shows is serviceable as a substitute for lamp black, carbon black, etc., in paints, with the advantage that the mineral ingredient of the carbonized mass serves as a filler. Mr. Lamb heats the pulverized press-cake (U. S. Pat. No. 1,424,729) by direct flame in an open pan until the gases evolved from the decomposition of the retained oil and coloring matter catch fire, when the heat is so regulated that the mass burns quietly with such agitation as may be necessary to promote thorough carbonization. A black color progressively is developed; when it attains its maximum depth heating is stopped, the mass is cooled and ground in a ball mill to the degree of fineness desired.

A supplemental pigment may be obtained by effecting carbonization with limited access of air whereby the carbonaceous material of the smoke is collected separately or made to precipitate upon and through the black residue. The decomposition and carbonization of the oil throughout the mass of fullers' earth result in a most intimate production and deposition of the carbon black in and upon the particles of the earth, so that the product has an intense black color. The black color thus imparted to the earth may be considered to be due to three causes, viz.: (1) to the actual formation of finely divided carbon from the oil within the body of the fullers' earth; (2) the precipitation of the oil smoke in a finely divided state within the mass of the fullers' earth; and (3) the incorporation of the lamp black separately precipitated from the smoke, when this separately produced lamp black is admixed with the original composite pigment. The fullers' earth, which is itself of a porous structure, appears to be intimately coated or plated with the deposited black. As a result, the composite product, although of an intense black color, nevertheless has a relatively large amount of fullers' earth intimately combined therewith, so that the composite pigment can be used to particular advantage for purposes where a pigment having considerable body, as well as an intense black color, is desired.

The composite pigment also can be used for other purposes where a black pigment or compounding or coloring material is desired, for example, as a constituent of printers' ink, or shoe polish, in substitution for part of the black pigment commonly used. In general, the new composite black pigment can be used for many of the purposes for which lamp black and similar carbon blacks are now used, and with the advantage that not only a black color, but a substantial body is provided by the composite product. It also can be used to advantage for compounding with rubber, as a substitute for lamp black, in part or in whole, and it will impart to the rubber improved or modified properties owing to the composite character of the product.

Photographic Film

In the development of a solvent which will dissolve such large proportions of cellulose ethers that thick or suitably viscous flowable solutions may be obtained for use in plastics and film manufacture, and to provide a cellulose ether solution suitable for the manufacture of strong, flexible, transparent film by the methods and in the apparatus now in customary use, Stewart J. Carroll, of the Eastman Kodak Co., Rochester, N. Y., has discovered that an adequately strong and useful solvent may be prepared by mixing ethyl acetate, ethyl alcohol and water. The addition of water to the combination causes a very noticeable increase in the solvent action and does not impair the transparency or strength of the final film when produced under the standard manufacturing conditions.

Lilienfeld U. S. Pat. No. 1,188,376 disclosed a series of alkyl ethers of cellulose, of which certain ones are practically insoluble in water. Mr. Carroll's invention, U. S. Pat. No.

1,425,173, is concerned chiefly with the ethers having this latter property. While such ethers form thin solutions in various single solvents, like ethyl alcohol, and while such single solutions are often useful for various purposes, it has been found that such solutions do not contain a sufficient proportion of the ethers to make the viscous flowable compositions or dopes which may be worked into photographic film base by the customary methods.

Mr. Carroll combines 90 parts of ethyl acetate and 7 parts of ethyl alcohol with 3 parts of water, the proportions being by weight. 400 to 800 parts of this solvent mixture will dissolve approximately 100 parts of ethyl cellulose, for example. The resulting dopes, when thoroughly mixed and filtered if desired, may be worked up into transparent, strong, flexible sheets or films. Not only may these proportions be varied, but other substances which impart additional suppleness or incombustibility, or other desired qualities, to the finished film may be added to the dope, such modifying agents being, for instance, triphenyl phosphate, tricresyl phosphate, camphor and the like. All of the ingredients are of the commercial type, sufficiently purified for the process of film manufacture, so as to give a homogenous dope yielding films of the proper transparency and relative freedom from color.

Arsenate of Lead Manufacture

Arsenate of lead is in extensive and growing demand as an exterminator of leaf-eating insects. It is an established fact that arsenate of lead of the formulae $PbHAsO_4$ is a quicker and stronger poison than normal arsenate of lead of the formulae $(Pb)_3\ (AsO_4)_2$. Furthermore for most effective and economical results, an arsenate of lead must be very light and fluffy in order to insure even distribution when used either as a wet spraying or dry dusting material and also should be exceedingly finely divided that the individual particles may become lodged in the minute indentations of the surface of the flower or foliage.

Austin O. Allen, of John Lucas & Co., Inc., Philadelphia, Pa., has found that when arsenate of lead is manufactured from basic acetate of lead, a considerable quantity of normal arsenate of lead is formed according to the following reactions:

$$PbO + 2HC_2H_3O_2 = Pb(C_2H_3O_2)_2 + H_2O.$$
$$Pb(C_2H_3O_2)_2 + PbO + H_2O = 2Pb(OH)C_2H_3O_2$$
$$3Pb(OH)C_2H_3O_2 + 2H_3AsO_4 =$$
$$Pb_3(AsO_4)_2 + 3H_2O + 3C_2H_4O_2.$$
$$3PbO + 2HC_2H_3O_2 = Pb(C_2H_3O_2)_2.2PbO + H_2O.$$
$$Pb(C_2H_3O_2)_2 2PbO + 2H_3AsO_4 =$$
$$Pb_3\ (AsO_4)_2 + 2C_2H_4O_2 + 2H_2O.$$

There also is a strong tendency for acid arsenate of lead to be converted into normal arsenate of lead in the presence of even small amounts of lead acetate (sugar of lead). Pure arsenate of lead manufactured from nitrate of lead does not have the desired physical properties. Mr. Allen obtains the pure acid arsenate of lead with fluffy physical properties by precipitating arsenate of lead from a basic solution of lead acetate and lead nitrate with arsenic acid, when the percentage of lead nitrate is just sufficient to insure the formation of a pure acid arsenate of lead.

Procedure

To a 3,000-gallon tank, with agitator, containing 2,000 gallons of water are added 165 lbs. of 70 per cent. acetic acid which is sufficient to convert 640 lbs. of litharge into tribasic acetate of lead in accordance with the following reaction:

$$3PbO + 2HC_2H_3O_2 = Pb\ (C_2H_3O_2)_2 2PbO + H_2O$$

With agitation are now added 16.5 lbs. of 40° Bé. nitric acid, followed by 640 lbs. of litharge. The batch is now heated with live steam to 120° F. Upon the conversion of all the litharge into lead salts, indicated by the milky appearance of the liquid and the absence of the yellowish tinge, due to the presence of litharge, are added slowly 5.15 lbs. of arsenic acid of approximately 63 per cent. $As_2\,O_5$, about one hour being required. Agitation is continued for twenty-five minutes, after which a sample of the filtrate is tested for the presence of lead salts and arsenic acid. The filtrate should show a very slight trace of lead salts and no arsenic acid, to secure which balance small amounts of litharge or arsenic acid may be added. The batch then is thoroughly washed in a filter press, the first portion of the wash water being returned to the filtrate. The cakes of acid arsenate of lead are then removed from the press, dried and pulverized.

The filtrate from this batch containing acetic acid, nitric acid and small quantities of acetate of lead and nitrate of lead is now pumped into the precipitating tank. Practice has shown that there will be a loss of approximately 3 per cent. of the acetic and nitric acids. To this amount approximately five lbs. of 70 per cent. acetic acid and one-half lb. of 40° Bé. nitric acid is added, followed by 640 lbs. of litharge, which latter is added while the agitator is running. The temperature is then raised to 120° F., and the process continued as described above. The process thus becomes continuous, and the loss is very small.

The reactions involved in the process are as follows:

$$3PbO + 2HC_2H_3O_2 = Pb\ (C_2H_3O_2)_2.2PbO + H_2O.$$
$$Pb\ \ (C_2H_3O_2)_2.2PbO\ + \ 2H_3AsO_4 =$$
$$Pb_3\ (AsO_4)_2 + 2C_2H_4O_2 + 2H_2O.$$
$$PbO + 2HNO_3 = Pb\ (NO_3)_2 + H_2O.$$
$$Pb_3\ (AsO_4)_2 + 2HNO_3 = PbHAsO_4 + Pb\ (NO_3)_2.$$
$$Pb\ (NO_3)_2 + H_3AsO_4 = PbHAsO_4 + 2HNO_3.$$

Mr. Allen, U. S. Pat. No. 1,427,049, thus manufactures a pure acid arsenate of lead or, as it is technically known, diarsenate of lead, possessing physical properties rendering it ideal for use as insecticide. The acid arsenate of lead is free from soluble salts, making possible the use therewith of various types of spreaders, since there are no appreciable percentages of soluble salts or free litharge present to enter into combination with them and destroy their function as spreaders. It also is possible to recover and make use of practically all acids liberated in the process.

Manufacturing Dextrin

Dextrin is manufactured by roasting or heating starch which is usually acidulated, the material being in agitation during the process so as to prevent caking or gelatinizing of any portion to the detriment of the product. If a uniform product is to be obtained it is essential that the heat be applied equally to the entire batch under treatment. The starch when introduced into the dextrinizing vessel contains ordinarily some water—commercial starch has ordinarily a moisture content of about 7 per cent. to 13 per cent. by weight—besides which there is the nitric, hydrochloric or other acid with which the starch is acidulated. This moisture is vaporized by the roasting or heating operation, and there is a tendency always for the vapors to condense, particularly against the top wall of the vessel. If this takes place the drops of water of condensation, falling back into the material, form gelatinized, or partially gelatinized, lumps, with the result that the product is not homogeneously dextrinized throughout.

Joseph J. Merrill, of the Corn Products Refining Co., Chicago, Ill., has devised an improved form of apparatus—U. S. Pat. No. 1,425,497—whereby dextrinization is conducted in a manner to yield a purer, more homogeneous and whiter product in relatively large batches and at a higher temperature than is customary whereby the manufacture is carried on more rapidly and economically. In operating the equipment, which consists essentially of a cylindrical vessel, surrounded with steam coils and provided with an agitator and openings for the introduction and discharge of acidulated starch and for the injection of superheated air and ejection of vapors, a batch of starch, after having been acidulated, is run into the dextrinizing vessel through the starch inlet. The agitator is set in motion, and steam turned into the steam coils. As the vapors are developed through the heating of the starch they are carried out of the vessel by the draft of superheated air, which is discharged at the opposite side of the dextrinizing vessel.

The side walls and top wall of the vessel are heated so that there is no possibility of any condensation of vapors on these walls. As a result of this arrangement it has been found possible to turn out a very high-grade of dextrin, even when the product is manufactured in large batches. The material under treatment is kept in constant agitation so that gelatinizing or overheating of any portion of the batch is prevented. The apparatus is suitable for use in the manufacture either of the products known commercially as dextrins, or of kindred products, such as British gum, and the like.

Vegetable Albuminoid Food

Ansil Moffatt, Indianapolis, Ind., seeks to eliminate the animal by the production of a proteid food which chemically has the constitution and nutritive value of lean meat or cheese, but which can be produced more quickly and economically, and with many times the yield of final food produced, than can be obtained by feeding the grain to animals and using the meat from them. Mr. Moffatt subjects any cereal, preferably maize, to an amylolytic agent until the starch and other carbohydrates, except cellulose, are rendered soluble. The residue comprises insoluble albuminoids or proteids, together with the fats and such fibrous cellulose and mineral matter as many have been present in the grain. This residue is a nutritious food, which may be rendered palatable by introducing various flavors and condiments, or other additions, and by expressing the water until the residue attains the desired consistency.

In the procedure employed, U. S. Pat. No. 1,425,033, corn.

either whole or coarsely ground, is steeped in water acidulated to the extent of 0.5 per cent. with hydrochloric or sulphuric acid, and heated to the boiling point and there maintained until, on testing, no portion gives the starch reaction with iodine. On the conversion of all starches into sugars the residue is separated by draining and is thoroughly washed to separate all soluble matter, whereupon it is pressed into cakes of the consistency of cheese. Before pressing the albuminoid residue may be ground in suitable mills to render it homogeneous, and any desired flavors or condiments, or other matter which it is desired to mix with it, may be introduced conveniently in the grinding operation so as to produce the desired flavor.

These cakes are a vegetable albuminoid food, containing the nitrogenous matters of the original raw material, together with such fats, fibre, and mineral matter as may have been in such raw material, but being entirely free from starch, sugar, and other similar carbohydrates. This food is thus produced direct from the grain without the intervention of the animal economy.

Recovery of Zinc Dust as Zinc Oxide

In the production of certain organic compounds, as, for example, benzidine, zinc dust is used as a reducing agent. There is obtained as a by-product from such processes a mixture containing zinc oxide contaminated with organic matter, solvents and certain inorganic impurities, such as sodium hydroxide, carbonate, chloride, etc. Before such by-product zinc oxide possesses any value for application for other purposes it must be freed from these impurities. James E. Borge, of E. I. duPont de Nemours & Co., effects such purification of this by-product zinc oxide as to make it suitable for use as a substantially pure zinc oxide.

As a first step in the purification the by-product zinc oxide is calcined at or below red heat, with or without agitation, and in the presence of air, to volatilize or oxidize any organic material or unoxidized zinc which may be present. Residual solvent is, of course, vaporized, whereas non-volatile organic material is burned out in this treatment. As a second step the calcined zinc oxide, preferably in a finely, subdivided state, is washed thoroughly with water. Such washing may be accomplished in a classifier or by a batch process in suitable tanks by means of successive agitation and decantation. The extent of such treatment should be regulated by tests of the wash water for soluble salts and the treatment continued until no appreciable amount of soluble salts, such as hydroxide, and chloride of sodium, are being bleached out. After each change of water the zinc oxide is well agitated, after which settling is allowed to take place.

With some types of by-product zinc oxide rapid settling does not occur. The material remains in suspension almost indefinitely, presumably due to assumption of a more or less colloidal state, with absorption of the ions of the soluble salts still present. This difficulty can be overcome, however, by addition to the wash water of a very small amount of sulphuric acid. In this way the colloidal suspension is coagulated and the oxide settles readily. The purified oxide can then be filtered in any suitable manner and the filter cake dried. In this manner a substantially pure zinc oxide is produced which is suitable for the numerous well-known applications of this material.

Recovery of Sludge Acid in Petroleum Refining

Crude petroleum oil or its fractional distillates are refined by subjecting them to the action of sulphuric acid so that the latter will absorb the heavy hydrocarbons and other undesirable elements present in the crude oil. In practice the sulphuric acid so used has an initial strength of about 66° Bé. or stronger, but at the completion of the operation, and after the refined oil has been separated, there remains a sludge or waste or spent acid, which not only contains the impurities removed from the oil, but is also of a reduced strength, usually about 50° Bé., due to the fact the acid has absorbed a certain amount of water during the refining process. This sludge acid generally is then subjected to further dilution with steam [illegible] remain therein, and for the purpose of relieving the acid as [illegible]

This secondary treatment results in further diluting the [illegible] fore, in order to reclaim or recover the sulphuric acid from [illegible] in the acid be broken up, and the volatile impurities thereof be driven off, so that with the removal of such volatile impurities foreign matter remaining in the acid will be principally in the nature of inert carbon which is incapable of reducing the efficiency of the reclaimed sulphuric acid when the latter is again used in the refining of oil.

Heretofore the generally practiced method of recovering, reclaiming and concentrating sludge acid has been to run the sludge into a suitable still and to subject it to external heat until the desired temperature and strength have been reached. This common method is admittedly inefficient because of the large heat losses, and is expensive as the stills are rapidly destroyed in operation, and require frequent replacement.

To reclaim and concentrate the sludge acid by passing hot air or hot gases directly through the acid does not admit of sufficient heat because the violent agitation set up by the air or gases causes a cooling of the acid and prevents its temperature reaching a point above from 400-450° F. This comparatively low temperature is insufficient to break up the objectionable hydrocarbons and to eliminate the volatile impurities, so that undesirable components are still present when the acid has been concentrated to its desired strength. I. Hechenbleikner and Thomas C. Oliver, Chemical Construction Co., Charlotte, N. C., have found that if the body of sludge acid can be internally heated to a temperature of from 540 to 560° F., for 1-6 hours, the volatile impurities will be driven off and the undesirable hydrocarbons either eliminated entirely or reduced to substantially inert carbon which is incapable of affecting the efficiency of the acid for reuse.

In carrying out the process, which is claimed, U. S. Pat. No. 1,415,443, to effect the recovery of spent acid with greater rapidity, economy and convenience than by usual methods, the spent or sludge acid is passed down through a packed absorption tower counter current to hot gases which are passed through the acid collected in a trough-like receptacle divided into two sections, viz., an acid-concentrating section and an acid-purifying section which is an extension of the former; in the former, the spent acid descending from the tower is agitated and concentrated and in the latter the remaining undesirable impurities are reduced to an inert state, resort being had to heaters, submerged in the body of the acid in both sections through which pass hot air or hot gas under pressure, which, in the purifying section is admitted at a temperature of 1150-1350° F., whereby the body of static acid is heated to about 550° F., after which the hot gases pass into the heater submerged in the acid in the agitating and concentrating section, from which it emerges to pass up the absorption tower counter current to the descending stream of raw sludge acid.

Metal Soaps for Waterproofing

The use of insoluble metal soaps, zinc, copper, lead, calcium, aluminum soaps and the like, for waterproofing porous surfaces is known. The soap either has been painted on, dissolved in benzine, turpentine oil or the like or it has been produced only in the surface. In order to produce metal soaps in the surface, this surface is painted or impregnated either first with the solution of an alkaline soap and then with the solution of a convenient salt of the metal in question or with alkaline solutions which contain an alkaline soap and the hydroxide of the metal. The latter process is based upon the observation that aqueous alkaline solutions of metallic hydroxide can be admixed with those of alkaline soaps without the separation of the metal soap from the mixture, this metal soap forming only in the porous surface after the solution has evaporized. According to one process a liquid is used for the painting which consists of soap solutions in addition to an alkaline or ammoniacal solution of the hydroxides of the zinc, copper, lead, tin, chromium or aluminum.

Otto Ruff, of Breslau, Germany, has found out that the indirect method used at present for producing an efficacious [illegible] soap with the [illegible] solutions is not necessary. A colloidal solution of zinc soap could be produced directly and painted upon the porous surface. In order to obtain the colloidal solution of the zinc soap it is merely necessary to add a little ammonia. The ammonia plays then the part of a peptizing agent. Mr. Ruff has been [illegible] ough lixiviation with water, together with a solution of a lit- [illegible] painting or impregnation.

Personal Items

W. W. Wood, analytical chemist, Jacksonville, Fla., has established a branch laboratory at Lakeland, Fla.

* * *

Dr. F. F. Shetterly, director, Kingsport, Tenn., plant, Corning Glass Works, has been transferred to the Corning, N. Y., plant.

* * *

Raymond K. Bowdin, '20 Ohio State University, has been appointed instructor in metallurgy, Carnegie Institute of Technology, Pittsburgh, Pa.

* * *

Dr. J. L. Beeson, for twenty-five years professor of chemistry at the Georgia State College for Women, Milledgeville, Ga., has been elected acting president of the college.

* * *

G. G. Lindgren, of the Air Reduction Sales Company, 342 Madison Avenue, New York, succeeds H. G. Boyer as district manager of the Birmingham, Ala., plant.

* * *

Arthur C. Trask has been elected president, and Victor J. Poll vice-president of the Falk Co., Inc., manufacturers and importers of oils and fatty acids, Pittsburgh, Pa.

* * *

Wm. A. Ernst, formerly chief chemist, National Cement Co., Ragland, Ala., has resigned to accept the same position with the Gulf States Portland Cement Co., Demopolis, Ala.

* * *

Leslie H. Webb, vice-president in charge, Wedge Mechanical Furnace Co., a subsidiary of the Pennsylvania Salt Co., has been put in charge of the Pittsburgh office of the latter corporation.

* * *

Charles Steinmetz, electrical engineer, General Electric Co., Schenectady, N. Y., has accepted the nomination on the New York state socialist ticket for the office of state engineer and surveyor.

* * *

H. E. Robertson, formerly with S. C. Cutler, consulting engineer, and George Walker, formerly with the Dorr Co., are recent accessions to the research staff of the Grasselli Chemical Co., Cleveland, Ohio.

* * *

Chester J. Pegg, formerly assistant superintendent, Tidewater Portland Cement Co., Union Bridge, Md., has been made general superintendent, Limestone Products Corp. of America, Newton, N. J.

* * *

Leon W. Parsons, assistant director, Research Laboratory of Applied Chemistry, Massachusetts Institute of Technology, has resigned, effective November 1, to become chief chemist, Tidewater Oil Co., Bayonne, N. J.

* * *

J. A. Steffens, for the past five years chemical engineer, research laboratories, U. S. Industrial Alcohol Co., South Baltimore, Md., has resigned and will engage in business for himself in New York.

* * *

Dr. George Barsky, formerly a research assistant of Prof. Ralph H. McKee, Department of Chemical Engineering, Columbia University, has been appointed to a position in the research department of the Abitibi Paper Co., Abitibi, Ontario.

With the resignation of Dr. H. P. Talbot as head of the department of chemistry, Massachusetts Institute of Technology, to become dean of students, Dr. Frederick G. Keyes, director of the research laboratory of physical chemistry, has been appointed acting head until a successor is selected.

* * *

Robert J. Thompson, who has been engaged on the co-operative work between the Vanadium Corp. of America and the U. S. Bureau of Mines, at Ithaca, N. Y., has joined the staff at the research laboratories of the National Canners Association, Washington, D. C.

* * *

Frederick Hochstetter, Hubert Estabrook and Samuel L. Finn, of Dayton, Ohio, have incorporated the Hochstetter Research Laboratories Co., with capitalization of $100,000, to engage in scientific research and manufacture. They are respectively president, secretary and treasurer.

* * *

Joseph A. Wolf has incorporated the General Testing Laboratories, 525 Woodward avenue, Detroit, Mich., with himself as president and Paul H. Kramer as secretary-treasurer. Its facilities will be devoted to general chemical and physical analysis and research work.

* * *

Dr. Ralph T. Goodwin, who took his degree this summer in the Department of Chemical Engineering of Columbia University, has joined the staff of the research department, Standard Oil Co. of New Jersey. Dr. Goodwin will have as his special concern the shale oil interests of the company.

* * *

Robert T. Haslam, formerly in charge of the school of chemical engineering practice, succeeds Robert E. Wilson, resigned, as director of the research laboratory of applied chemistry, Massachusetts Institute of Technology. Mr. Wilson has joined the research staff of the Standard Oil Co. of Indiana, Whiting, Ind.

* * *

Dr. R. R. Shively for the past four years incumbent of the Monongah Glass Co.'s Industrial Fellowship at the Mellon Institute of Industrial Research, and chemical engineer for the company in its plant at Fairmont, W. Va., is now with B. F. Drakenfeld & Co., 50 Murray St., New York, as chief technologist.

* * *

Recent accessions to the staff of the research laboratory of the Eastman Kodak Co., Rochester, N. Y., comprise: Alasco Burgess, '22, Bates College; Roger P. Loveland, '19, Grinnell College; Clyde Brackett, '22, and D. H. Harris, '22, M. I. T.; and Dr. Helge Schibsted, formerly with the Atmospheric Nitrogen Corp.

* * *

E. A. Holbrook, assistant director, U. S. Bureau of Mines, has been appointed dean of the mining school at Pennsylvania State college, effective October 1. He is succeeded by A. W. Ambrose, chief petroleum technologist of the Bureau. The duties of F. J. Bailey, assistant to the director, have been increased by assigning to him virtually all of the business matters of the Bureau formerly handled by the assistant director.

Industrial Notes

The Corn Products Refining Co., will spend $3,000,000 for improvements to its plants at Edgewater, N. J., and Pekin and Argo, Ill. The company's plants in France and Germany also will be enlarged.

* * *

Burrows Wellcome & Co., English manufacturers of pharmaceutical products with offices at 18 E. 41st St. and factory at 340 Hudson St., New York, have acquired premises at 9-11 E. 41st St., under a 105-year lease and will erect a 12-story office structure for occupancy and rental.

* * *

Carbocite, Inc., capital $250,000, Huntington, W. Va., has been organized by S. J. Hyman, president, R. D. Lamies, vice-president, and Fred. Livezey, secretary, to take over the contract of the Huntington Coal Distillation Co. The company will erect a plant to manufacture and refine coal by-products.

* * *

Union Sulphur Co., 33 Rector St., New York, has purchased from the Texas Exploration Co. the sulphur deposit at Damond Mound, near Brazoria, Tex., consisting of approximately 215 acres with proven deposit of over 14,000,000 tons of sulphur. It is said that the company will construct mining, refining and terminal plants costing up to $6,000,000.

* * *

The Lindsay Light Co., manufacturers of gas mantles, lighting equipment and chemicals, is considering the purchase of the property of the Block Gas Mantle Co., Youngstown, Ohio, whereby its business may be concentrated and operated with greater economy. Increase of capitalization is contemplated if the stockholders confirm the plans of President Joseph M. Sherburne.

* * *

The Allied Chemical & Dye Corp., 61 Broadway, New York, through Dr. William H. Nichols, chairman of the board and former president of the American Chemical Society, has provided for a prize of $25,000 to be awarded annually to the most notable American contributor to chemical science. The award will become operative next year and will be made by a committee, of which Dr. Edgar F. Smith is chairman.

* * *

Dominion Oxygen Co., Ltd., and the National Electro Products, Ltd., have united under the former title with amalgamated manufacturing and distributing resources which give this new Canadian company a foremost position in oxygen manufacture. Oxygen plants are operated at Montreal and Toronto, and acetylene plants at Merritton, Winnipeg and Shawinigan Falls. In addition the company conducts oxygen and acetylene distributing stations at Hamilton, Windsor and Quebec.

* * *

The Imperial Oil Co., Ltd., subsidiary of the Standard Oil Co., of New Jersey, will build a $2,500,000 oil refinery at Calgary, Alberta, Canada. Crude oil will be obtained first from the Montana field. The Imperial Oil Co. is at present prosecuting drilling operations at ten different points in Alberta, ranging from a few miles north of the international boundary to the Fort Norman district within the Arctic Circle. It is believed that plans for refinery development of such proportions is based upon the expectation of successful results of drilling activities.

Announcement is made of the incorporation, under the Webb law which permits for export purposes association which would contravene the Sherman anti-trust Act, of an organization comprising the Texas Gulf Sulphur Co., Union Sulphur Co. and Freeport Sulphur Co. It is thought that this step will result in substantial benefits to the companies. The executive officers of the newly organized Sulphur Export Association will be: President, C. A. Snider; executive committee, Henry D. Whiton, Union Sulphur Co.; E. P. Swenson, Freeport Sulphur Co., and W. H. Aldridge, Texas Gulf Sulphur Co. A board of directors will be selected comprising two representatives from each of the three companies.

* * *

The National Lead Co., 111 Broadway, New York, in acquiring a substantial interest in the Compania Minera deLlallague of Bolivia, the largest single tin producer in the world, has intrenched itself strongly in control of tin resources. Its annual requirements of tin amount to 10,000 tons, being exceeded only by the U. S. Steel Corp., which consumes 14,000 tons yearly. The world's tin production amounts to 100-120,000 tons, 40,000 tons of which come from Bolivia, the remainder from the Straits Settlements. American consumption of tin aggregates 40,000 tons per year. Control of the Bolivian mines now rest with the National Lead Co. and Simon Patino, each also owning a one-third interest in Williams Harvey Co., Ltd., of England, the largest tin smelters in the world, and in the Williams Harvey Corp. of New York, also a tin smelter. National Lead Co.'s investment in the Llallague mines is about $1,500,000.

* * *

The artificial silk plant of Cupra, Inc., now under construction at Clifton, near Paterson, N. J., was designed by the Technical Advisory Corp., architects and engineers, 132 Nassau St., New York. It is expected to be completed by December 1 and in operation by February 1. Cotton linters will be the raw material and the process the cupra-ammonium. The executive personnel comprises: R. P. Dicks, formerly president, Dicks-David Co., president; O. G. Pratt, formerly vice-president and chief engineer, Aetna Explosives Co., vice-president; Wm. H. Doherty, of the Doherty Silk Co., secretary; and Francis T. Tilton, Clifton, N. J., treasurer. Initial daily output will be 1000-2000 lbs. with indefinite capacity for expansion. The product will be chiefly of 150 derniers but a complete range is in prospect. Unusual interest attaches to the development of this enterprise located as it is at the chief center of silk production in the United States.

* * *

The Standard Oil Co. of New York is said to have completed plans for the construction of a petroleum refinery at Sparkill, Rockland Co., N. Y., on the west side of the Hudson River, where it has acquired a 1,500-acre tract served by the Erie and West Shore railroads and fronting on the river at the most northerly point of deep water navigation. The New York Transit Company has been granted the right to build a pipe line connecting the property with Western oil fields. In addition, oil can be taken up the river in barges from Mexican, South American, Gulf Coast and Atlantic ports.

CHEMICAL
AGE

A CONSOLIDATION of THE CHEMICAL ENGINEER and CHEMICAL AGE
LLOYD LAMBORN, *Editor*

VOLUME 30 NEW YORK, NOVEMBER, 1922 NUMBER 11

How the College Can Facilitate Payment of the Debt It Owes to Business

By Dr. Edward Ellery
Dean of the Faculty, Union College

COLLEGES owe a tremendous debt to Business. Every college officer knows that. Out of the profits of business come endowments. Without endowments colleges could not exist. Research workers in pure learning, as distinguished from applied learning, find in the college realm their opportunity to work and their income both made possible by endowments. The youth of all classes, whether American or foreign-born, secure through the colleges a mental training beyond the high school at a good deal less than cost.

DR. EDWARD ELLERY,
Dean of the Faculty, Union College.

The Debt of the College

The college students do not pay for the maintenance of the college. It costs anywhere from ten per cent. to fifty per cent. more to conduct colleges than the students pay. The deficit is not made up by taxes. The public is willing to tax itself for schools, but in the Eastern States not for colleges. Where does all that extra money come from? Largely from income on endowments, and endowments have their source in the profits of business. That, in brief, is the debt.

Confidence of the Creditor

Business has never exacted payment in the sense of demanding immediate, direct and definite return for its money gifts. Business has been content if college equipment has been used for the advancement of learning, and college funds for its wide distribution. Business has not demanded that research work should be "practical," nor has it limited the use of its gifts to the fields of science, whether pure or applied. Business has been satisfied with new discoveries in art and history and music and literature. It has been willing that its gifts should provide splendid and beautiful housing and surroundings. Business has even been willing to contribute millions for Coliseum-like structures in which a few superbly trained and carefully selected combatants present spectacles for a multitude.

Diligence of the Debtor

The colleges have given good account of themselves to business. No one who knows anything about colleges doubts that. They have done all that has been required of them. They have brought from hidden depths great truths of science, announced and made clear unknown laws, brought forth satisfying explanations of mysteries, discovered new worlds, unearthed ancient civilizations and cultures, inspired and guided thousands of youth. Business itself, far from complaining about colleges, has shown by continued princely gifts confidence in them as the years have passed. The college may well feel that it has met, and is meeting, its debt to Business.

But it is always a fair question for any individual or institution to ask if he or it is a profitable servant when all has been done that is demanded. Does profit consist in meeting requirements, or does profit begin after requirements have been met? Is it not a fact that the men who have risen in business are the very men who acted upon the latter principle? The college can afford to ask itself, should ask itself, can it do anything more? Can it be of direct and immediate profit to Business? Can it contribute definitely to the profits of Business? I think it can, at least as far as the training of chemists is concerned. And in the following I show how the college can facilitate the payment of the debt it owes to Business.

Ways of Payment

First, it can train the powers of initiative. Much of college training consists of the passing of courses. To pass courses, for the most part, means the ability to reproduce at a stated time facts accumulated from either written or "spoken" textbooks. Lectures are often only "spoken" textbooks and deny the listener the opportunity for self expression—a pedagogical error. Laboratory practice can easily be of the "cook book" variety, where students follow line by line specific and detailed directions of procedure. "Take 2 c.c. of this and 5 c.c. of that," etc. That is, in fact, a necessary method, but why do it in just that way? When so done, all initiative is held in abeyance.

Can't texts and laboratory manuals be used in a way to make the student more independent? I think so. The assignment need never be so many pages a book, but rather a topic—say Boyle's law, for example; never an experiment with a given number, as Experiment 17, but rather a given preparation, as ether. A conference with an instructor before taking a single step will afford opportunity to show whether the student knows what he is about to do. Another conference with an instructor after the preparation is completed will show whether the student knows what has taken place. Less ground may be covered by the method, but the student is more independent and original, and that is a great gain—more valuable than a large fund of information.

Second, the college can train for constructive work in chemistry—in other words, can afford undergraduates opportunity for actual research. Four years of undergraduate work usually comprise General, Analytical, Organic, Physical Chemistry, with other branches, varying with different institutions. These are courses in which no deviation from a beaten path is possible or expected. There is no training for work in new and untried fields. Is that necessarily the best way of teaching? Is nothing else possible in the college chemistry course? Must we continue to do the thing as our fathers did it? Or can we improve the method and gain something? I think we can. The fundamental chemistry can safely be left to the secondary schools to do. Analytical Chemistry can be covered in a college year. Organic and Physical Chemistry can be covered in two college years. The fourth year in college can profitably be used for a research problem—a real problem involving training in research methods.

This constitutes a direct contribution to business. It reduces the period of unproductiveness that always occurs when the graduate enters business—the period when the graduate is adjusting himself to the requirements of industry. Time is a factor in profits. All time lost in adjustment is a loss to industry. If the period of lost time can be reduced, that is a clear gain. Industry asks to-day for constructive, not for analytical processes. This does not mean that there is no call for the analytical chemist; he will aways be needed. It does mean that old "rule of thumb" processes must be discarded, improved, explained. It means that new problems of frequent occurrence in a going industry must be met and solved. It means that new and hitherto unopened fields must be entered. The words "constructive chemist" describe the man whom the situation demands. When the college develops power of initiative and trains in construction methods, it is sending out young men prepared to take up without great loss of time the particular chemical problem of some industry. That is a great gain.

Conditions Precedent to Payment

To give some training in constructive chemistry, to afford opportunity to the student to experience what it means to work in a new field, to give a chance to show whether he has the pioneer spirit—as I have pointed out elsewhere, certain things are necessary.

I. SMALL INSTRUCTIONAL GROUPS DEMANDED

Small instructional groups are essential. There is much said these days about limiting the size of the college. It is doubtful if the college has a right to withhold its advantages from any who are equipped to meet its requirements. At least, if it has the right, the right must be based on its obligation to assume no greater burden of expense than it can reasonably expect to carry. But the college clearly has the right, yes the duty, to limit the size of the instructional group. A large group is an obstacle to good work in class or laboratory. Ten to fifteen is about the maximum a good chemistry teacher can handle at one time.

II. CLASSIFICATION OF STUDENT CAPACITY

Superior students must be separated from inferior students. The two cannot be taught together. The combination harms the superior and does not benefit the inferior.

III. PRUDENT DIRECTION OF PEDAGOGICAL EFFORT

The strongest teachers—those of the broadest experience—should be placed over freshmen and seniors. Young instructors of limited or no experience should be placed over sophomores and juniors. The first year of college life is relatively the most important of the four and requires the finest and surest pedagogy. The final steps in the training likewise require the careful, direct supervision of instructors of long and successful experience. Neither the first nor the last year are proper times for the pedagogical experiments of untried teachers.

IV. CONSERVATION IN PEDAGOGY

There should be a limitation of the number of students and of hours the good teachers teach. Fine pedagogy, as in every other relation of life where minds and spirits of human beings are in contact, takes "virtue" out of a man. One must be given time to re-accumulate the power.

This is a way in which the college can contribute directly to Business. Industries can well afford to help colleges keep instructional groups small enough to be individualized, to segregate superior students, and to assign the best teachers to the first and fourth-year men, for colleges will thus be able not only to produce better trained men, and more of them, but to reduce by a considerable amount the length of the unprofitable period of the new man in a plant.

Stainless Iron

Considerable publicity has recently been given to the development in England of a rustless or stainless iron and the uses to which such material may be put. Stainless steel has become a familiar class of material. It contains in the neighborhood of 13-16 per cent. chromium and usually 0.3-0.4 per cent. carbon. Rustless iron contains about the same proportions of chromium but its carbon content is lower, in the neighborhood of or less than 0.1 per cent.—a stainless steel with the carbon largely eliminated. Some of the advantages claimed for rustless iron over stainless steel are that the former is more ductile than the latter, more easily rolled or forged, does not require special heat treatment of the ingots before working, and machines more readily. It is said to have stainless or rustless properties close to those of stainless steel. It is also stated that marine growths will not adhere to plates rolled from rustless iron.—*Sci. Paper 448 U. S. Bureau Standards.*

The Federal Yeast Corporation, Baltimore, Md., capitalization $400,000, will utilize the recently built plant of the Colgate Food Products Co. at St. Helena, in that city, for the manufacture of yeast and vinegar, with a weekly capacity of 100,000 pounds of yeast and 14,000 gallons of vinegar.

Oxygen Production from Liquid Air

By K. S. Murray
British Oxygen Co.

As early as 1896 the British Oxygen Co., as the makers of Hampson's apparatus for the liquefaction of air became connected with low-temperature research. The Hampson apparatus, which is based on a nozzle, or free internal expansion, is so efficient in its temperature interchange, that when expanding about 700 cu. ft. of air from a pressure of 150 atmospheres to atmospheric pressure, it begins to produce liquid air in about 6 minutes with a yield of about 1 litre of liquid per hour. For the production of liquid air on a commercial scale, this apparatus is too small to be of any value. On the other hand it is specially designed for the quick production of liquid for research purposes, and it has been adopted for that purpose in many educational institutions, and research laboratories throughout the world.*

The success which attended the introduction of this apparatus, coupled with the still more important work of Prof. Carl von Linde on the liquefaction of air, pointed to a method for the separation of its constituents which might develop into a rival to the barium process. Consequently the British Oxygen Co., like other concerns, equipped with facilities for the production of liquid air, quietly experimented between 1896 and 1903 with various methods for separating the constituents of liquid air by partial evaporation. However, the problem remained entirely unsolved until the process of rectification was disclosed by Professor Linde in the latter year. From that date rectification has been the fundamental principle underlying every patented method for separating the constituents of liquid air.

The British Oxygen Co. was not long thereafter in realizing that its barium process for producing oxygen was seriously threatened by the introduction of rectification for separating the constituents of liquid air. It therefore concluded an arrangement with Professor Linde under which we acquired his British and British Colonial rights in rectification. In 1906 we erected in our Westminster works a Linde plant capable of producing about 500 cu. ft. of oxygen per hour. In 1908, as the outcome of prolonged litigation, which established Linde's claim to the rectification of liquid air, the company entered into an agreement with the Société l' Air Liquide of France under which we acquired the Claude British and British Colonial patents with the exception of Canada, for the separation of oxygen and nitrogen from liquid air. In many of our factories we have today Linde and Claude plants working side by side.

The Linde Plant and Its Operation

The Linde plant represents the earliest type employed for the separation of oxygen from liquid air. Such plants consist essentially of an air compressor; a suitable purifier for eliminating carbon dioxide; a drier for removing moisture from the air; a fore-cooler which is kept cold by means of an ammonia or a carbon dioxide machine; and finally, the separator containing the counter current heat interchanger and the rectification column. The working of such a plant is as follows:

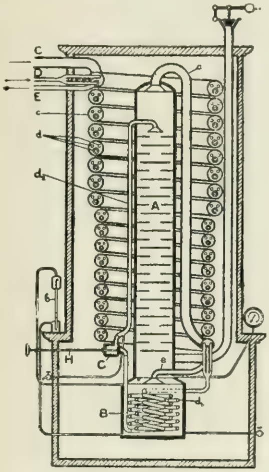


Fig. 1
Diagram of the Linde Process

Air is drawn by the compressor through a lime or caustic soda purifier to remove carbonic acid. It is then compressed, under conditions as nearly isothermal as possible, to about 135 atmospheres and passed through a calcium chloride drier to remove moisture. The compressed air then enters the fore-cooler where it is cooled to a temperature of about —30° C., any remaining traces of moisture being deposited there as ice, and finally passes to the separator of which a sectional elevation is shown diagrammatically in Fig. 1. The main pipe D conveying this compressed air to the apparatus is split up into three small pipes *d* at the point where it enters the counter-current interchanger coil C. It passes down these pipes, which are reunited into a single pipe d_1 when they leave the interchanger; this pipe *d*, which is coiled in the vaporiser B as shown, is attached to the inlet of the valve G. At this point, by the adjustment of the regulating valve spindle H the air is caused to expand from a high to a low pressure, and is discharged at this low pressure through the rose-ended pipe d^2 into the top of the rectification column A. The expanded air fills the column and then flows through the only two possible outlet pipes *c* and *e* which surround the small pipes *d*. Thus is formed a counter-current interchange of heat, as the outgoing expanded air descends the interchanger coil through which the high pressure air is descending in the small pipes *d*. The expanded cold gases, having thus abstracted heat from the incoming compressed air, leave the separator at C and E as indicated in the diagram, nearly at atmospheric temperature.

It is at the valve G that Linde obtains the Joule-Thomson cooling effect, and this is made cumulative by means of the counter-current heat interchanger. The apparatus is completely enclosed in a wooden casing and all spaces are packed with suitable insulating material, consequently, after starting the plant with everything at atmospheric temperature, the separator gradually cools down until some of the expanded air begins to liquefy and collect round the coils in the vaporiser B. The quantity of liquid thus collected is

---

The Bureau of Mines announces plans for investigation of the oxygen for the enrichment of the blast in the blast furnace and for all phases of pyro-metallurgical work. The study will embrace (1) present-day processes for the production of oxygen, in order to determine the feasibility of attempting to produce oxygen, or oxygenated air, in such amounts and at such cost as will permit its use in metallurgical operations, and (2) the feasibility of using it for these purposes.—Editor CHEMICAL AGE.

*A paper contributed to the symposium, "The Generation and Utilization of Cold," under the auspices of the Faraday Society and the British Cold Storage and Ice Association, London, October 16, 1922.

registered outside the apparatus by means of an ordinary colored liquid which is contained in a glass tube *b* enclosed in a pressure equalizing circuit as indicated. Once this stage is reached liquid begins to accumulate rapidly in the vaporiser B, and the initial pressure of the compressed air may be gradually reduced by increasing the opening of the valve G.

As the liquid begins to accumulate round the coils in the vaporiser B, the compressed air transmits some of its latent heat to the liquid. The latter is thereby evaporated whilst the compressed air is itself liquefied in proportion to the amount of heat thus extracted. The vapours thus produced flow upwards through the rectification column A, whilst the liquid formed in the compressed air pipe coil d_1 ascends through the pipe d_2, and is discharged through the rose-end at the top of the rectification column. The temperature gradient necessary for efficient rectification then rapidly becomes established in the column, and the final stage is reached under which the separation of oxygen is effected.

The pipes C and E of the counter-current interchanger then begin to fulfil their proper functions, the nitrogen vapours being delivered through the former from the top of the column and the oxygen vapours through the latter from the top of the vaporiser. The separated gases leave the apparatus at C and E respectively at or near atmospheric temperature, having abstracted heat from the incoming compressed air whilst passing up the counter-current interchanger.

This type of separator is easy to operate, and from an economical point of view has been found satisfactory hitherto for use in relatively small oxygen-producing plants. A defect of rectification in this form is that although oxygen of high purity can be produced, at least 7 per cent. of oxygen is contained in the waste nitrogen. With large plants this becomes a serious matter, and Claude was the first person to design a separator which obviates this loss. I will, therefore, now describe briefly a type of Claude plant capable of producing 4,000 cu. ft. of oxygen per hour, which is largely employed by the British Oxygen Co. at the present time in nearly all of their factories in Great Britain.

Operation of the Claude Plant

The outstanding features of Claude's plants are: (1) Cooling by means of an expansion engine; (2) a selective system of rectification rendered possible by a preliminary partial separation of oxygen and nitrogen; and (3) a combined system of heat interchange and drying which renders chemical abstraction of moisture from the air unnecessary.

Operation of the plant is as follows: Air is drawn by a compressor through purifiers to remove carbon dioxide as in the Linde plant. It is then compressed to a maximum pressure of about 33 atmospheres, and passed through two vertical tubular heat interchangers in series. In passing through the second of these it meets in counter current the cold separated oxygen and nitrogen passing outwards from the separator, and a very complete interchange of heat takes place. Here also most of the moisture is thrown down as water and drawn off at intervals, the remainder being arrested in the form of ice round the tubes at the top of the interchanger. Meanwhile, the first interchanger which had previously performed the same function, is being thawed out by the air passing through it, in order to be ready for subsequent use.

Thus these interchangers are operated, as such, alternately, being changed over at intervals of 8 hours. The compressed air leaves the second interchanger at a temperature of about —100° C. 60 to 70 per cent. of the cooled air goes direct to the expansion engine where, in expanding to about 4 atmospheres, it performs external work against a dynamo brake and issues from the engine at a temperature not far removed from its point of liquefaction. The remainder of the air passes under full pressure into an interchanger, termed the liquefier, where it is liquefied by meeting in countercurrent all the cold oxygen and nitrogen passing from the separator to the second, or operating, interchanger previously described. The cold vapour from the expansion engine and the liquid from the liquefier both enter the outer compartment of the liquid collecting vessel at the bottom of the vaporiser, the liquid supply being controlled by a valve, which performs the same function as the valve G in the Linde apparatus already described. By this skilful combination of internal and external expansion, Claude is able to obtain a high efficiency from his expansion engine.

An interesting addition to the Claude separator is a small nest of tubes in the centre of the vaporiser through which a quantity of rich nitrogen from the inner compartment can be withdrawn. After this additional scrubbing a relatively small, but useful, quantity of gaseous nitrogen of 99.5 to 100 per cent. purity, can be obtained as a by-product. All parts of the apparatus subject to temperatures below that of the atmosphere, are efficiently insulated and when working conditions are established, air is delivered by the compressor at a pressure of 26 atmospheres. 33 atmospheres, already mentioned as the maximum pressure, is the initial pressure employed to hasten cooling down. This is less than a quarter of the initial pressure required by Linde and other plants, which is not only a fine tribute to the efficiency of Claude's expansion engine, but this relatively low maximum pressure enables lighter material and more efficient design to be employed in the interchangers and elsewhere.

We find that these plants under daily working conditions produce oxygen of 98.5 per cent. purity for an expenditure of about 185 B. H. P. per hour or 46 B.H.P. per 1,000 cu. ft. of oxygen. The labor required for working the plant is no more than is required for a plant one-tenth the size. We do not employ larger plants than these as we find them to be a unit of convenient size for our oxygen factories. We do not employ Linde plants of larger capacity than 2,000 cu. ft. of oxygen per hour, but so far as the separator is concerned, these and all larger Linde plants are now similar in most respects to the Claude design.

In producing cold with these larger plants, Linde does not employ an expansion engine doing external work, but still relies on the Joule-Thomson effect produced by internal expansion of the air. On the other hand he economizes power by compressing only one-third of the air used to a constant pressure of about 135 atmospheres and the remaining two-thirds to 4 atmospheres. Thus like Claude he admits liquid and gaseous air to his separator and appears to obtain similar results with very little more expenditure of power.

I am not able to speak from personal experience of a Linde plant of greater capacity than 2,000 cu. ft. of oxygen per hour. This latter plant, however, absorbs about 106 B.H.P. per hour, or 53 B.H.P. per 1,000 cu. ft. of oxygen produced. Both Linde and Claude oxygen separators have been manufactured up to a capacity of about 9,000 cu. ft. of oxygen per hour. With such plants the power consumed per 1,000 cu. ft. of oxygen produced, is about 33 B.H.P. I believe the

Linde Company have also manufactured larger units, for which they claim still lower consumption of power, but the design and construction of efficient heat interchangers for large oxygen plants is likely to put a limit to their size, and I venture to doubt whether a plant with much lower consumption of power than 30 B.H.P. per 1,000 cu. ft. of oxygen is possible with due regard to economy in other directions.

Jefferies-Norton Process

Reference appropriately may be made to the Jefferies-Norton process, which we have repeatedly been assured would produce oxygen at 6d. or less per 1,000 cu. ft. The process appears to be based on the fact that heat interchange should take place between high pressure gases, in order to recover power by expansion more effectively than is the case in existing systems, where heat is transmitted from a high to a low pressure gas.

In Fig. 2, I give a very free diagrammatic illustration of the process as I understand it. Air at a pressure of say 20 atmospheres enters the system at A, and on its way to the rectification column B (which is operated at only a slightly lower pressure) it is made to pass through two interchangers, as diagrammatically illustrated, in order to heat up outgoing nitrogen and oxygen. The former of these first passes through its interchanger under full pressure. It is then split up as shown, about 60 per cent being heated by suitable external means at D to a temperature of about 550° C. This hot and fully compressed gas then passes to a motor E, which it drives, generating sufficient power, it is claimed, to work the whole system. The remaining 40 per cent of nitrogen, in order to help in counteracting heat influx, is expanded in the engine C, the expanded gas on its way out of the system being again employed as shown to abstract heat from the incoming compressed air. The separated oxygen leaving the rectification column under pressure passes as shown, to the expansion engine P, and the expanded oxygen on its way out of the system, is employed to abstract heat, as indicated, from the incoming compressed air.

In order to maintain the correct temperature gradient in rectification columns, it is necessary to have oxygen vapor at the bottom and nitrogen vapor at the top, but when the pressure in the column is nearly the same as that of the compressed air entering it, then the condensation of the latter in liquid oxygen cannot be effected and normal rectification cannot be set up. In order to get over this difficulty and transfer heat from the top to the bottom of his column, Norton places a coil K in the liquid oxygen bath at the bottom of the column through which an independent supply of oxygen, raised by the compressor F to a pressure above that prevailing in the column, is caused to flow after being first cooled by the outgoing oxygen vapor in G. The circulating oxygen is then condensed in the oxygen bath, and afterwards expanded through the valve H to a temperature low enough to condense nitrogen. It is then drawn through the coil M to be recompressed by the compressor F in the enclosed circuit.

The Jefferies-Norton process has had Government support in the U. S. A., where a large plant for the separation of helium from natural gas was erected at Petrolia, Texas. The plant never was successful, and I understand has now been abandoned, a plant erected by the Linde Air Products Co. during the war at Fort Worth, Texas, being employed instead. I have not heard of any Norton plant being successfully operated for the production of oxygen. Although the process has clever features and is refreshingly original, I am afraid most engineers who have had experience with very low temperatures will regard it as somewhat impracticable.

Lubrication of Equipment

Cylinder lubricating oil is a source of trouble in liquid oxygen plants in two respects, viz.: (1) traces are always liable to be carried forward and tend to foul up both interchanger pipes and the column, thus necessitating periodical and difficult cleaning; (2) the other, and more serious trouble, is in connection with the air compressor cylinders. The heat generated in each stage of compression, in spite of very efficient cooling, necessitates the use of special high flashpoint oils and precautions to ensure that the flash-point temperature is not exceeded. It has been proved, however, that any lubricating oil heated in in the presence of compressed air beyond its flash-point, breaks down into simpler substances including free carbon and acetylene. These substances, particularly acetylene, are liable to be carried forward in the air and to accumulate as solid particles, in liquid oxygen baths, thus producing conditions which have given rise to numerous explosions which have been almost invariably traced to the presence of acetylene.

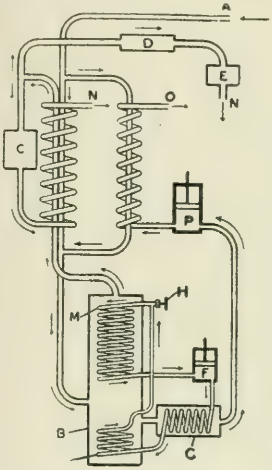


Fig. 2
Diagram of Jefferies-Norton Process

Liquid Oxygen

Hitherto, I have dealt only with plants producing a gaseous oxygen product. Liquid oxygen can always be drawn from such plants, but they are not the most convenient construction for the purpose. It is obvious that when some of the oxygen is drawn away in the liquid state its value in the interchangers for abstracting heat from the incoming air is lost. This has to be compensated for by increased pressure. Hitherto the demand for liquid oxygen has been practically restricted to rescue work and aircraft uses, but its employment for explosives, developed by the Germans during the war, is likely to extend and create a demand for plants primarily designed to produce liquid oxygen. The Société l'Air Liquide recently supplied a plant for this purpose to certain mines in Lorraine where German plants had hitherto been used.

The price of oxygen in the liquid state must always be more than in the gaseous owing to the greater expenditure of power involved in its production and losses due to evaporation in its use. We sell the liquid at infrequent intervals and small quantities, as drawn from the oxygen plants in our factories, at prices down to 1s. 4d. per lb. in Dewar vessels of small capacity, but to a regular and large consumer very much better terms could now be offered. In recent years, thanks to improved methods of constructing metallic Dewar flasks, the transport of liquid oxygen has become much simplified. In flasks of 25 litres capacity and upwards the loss due to ordinary evaporation I am told should not exceed 5 per cent in 24 hours.

Production Costs

As regards the cost of gaseous oxygen, this varies with the size of plant employed to a larger extent than in the case of the liquid. As evidence of the extent to which this occurs it is only necessary to compare the cost of producing gaseous oxygen by means of present-day liquid air plants of maximum and minimum sizes. For this purpose a plant producing 500 cu. ft. of oxygen per hour may be taken as the smallest practicable unit, and for the other extreme I will take a Claude plant producing 9,000 cu. ft. of oxygen per hour, for that is the largest size of which I can speak with adequate personal knowledge.

Assuming power in each case to cost 1d. per B.H.P. (a somewhat high figure for the larger plant) then working continuously to their full capacity, with adequate power, labor, material, and a fair proportion of all the usual standing charges, including interest on capital and depreciation, the cost of oxygen produced by the small plant would be 19s. and by the large one 4s. 6d. per 1,000 cu. ft. If these plants were worked intermittently so as to produce annually only half of their full output, the standing charges would be greatly in favor of the large plant. I estimate that the cost of oxygen would then be with the small plant 27s. and with the large 6s. 3d. per 1,000 cu. ft. These costs are into the gasholder. In the case of oxygen factories supplying the gas in cylinders it is obvious that the cost must always be much higher.

In its plants in Great Britain, the British Oxygen Co. has a total daily production capacity of 2 million cu. ft. of oxygen. Our present sales fluctuate between 4 and 5 million cu. ft. per week, which is less than half the total capacity of our plants. Our present average price for oxygen in cylinders is about 38s. per 1,000 cu. ft., although to many large consumers the price is substantially lower.

The secret of cheap oxygen is large liquid air units worked to their full capacity. By having increased the size of our factory units since the war we are able now to sell oxygen below our pre-war price. The oxygen business has become a good barometer of trade. It has suffered severely during the prolonged industrial depression, but the demand has been perceptibly increasing within the last two months.

Uses for Oxygen

The amount of oxygen sold in Great Britain for medical purposes of every kind probably does not exceed 1 per cent of the total output in cylinders. About 3 per cent is used for limelight and experimental purposes. All the rest goes to industry. Of the industrial uses for compressed oxygen the most important now is metal cutting. This must represent over 50 per cent. of the total demand, and is about equally divided between scrap-cutting, or destructive work, and much important constructive work. The latter is perhaps one of the most important outlets for oxygen.

Oxy-acetylene welding ranks next to metal cutting amongst the industrial applications of oxygen. About 25 per cent of the gas sold in cylinders is employed for that purpose, and it is becoming obvious that oxy-acetylene welding can easily hold its own in a great variety of work against electric welding and other processes. The remainder of the oxygen sold in cylinders is used mostly for lead burning purposes, and for obtaining high temperatures in special metallurgical operations.

In the wider fields of industry where the use of oxygen has often been suggested, as for instance in the enrichment of air for blast furnaces, and in connection with steam, for the continuous gasification of fuel, it is doubtful whether the stage has yet been reached when oxygen can be produced cheaply enough even in large plant units to be economically employed. In Germany, oxygen is used in the manufacture of nitric acid and acetic acid, but otherwise neither in that country nor any other, so far as I am aware, has the use of oxygen yet developed to any appreciable extent in the chemical industry.

It must be admitted that industrial development throughout the world is still mainly confined to the cylinder trade. In Great Britain, in spite of trade depression, the quantity of oxygen distributed in cylinders at the present time must approach 300 million cu. ft. per annum of which upwards of 225 million are supplied by the British Oxygen Company. In France I believe the annual output is about the same as in Great Britain, but it is stated to be three times as much in the United States and more than twice as much in Germany.

Apparently, it is estimated by Mr. Murray that for large plants the lowest cost would be about $1.00 per thousand cubic feet by the Claude process as operated by the British Oxygen Company. Our own computations approximately confirm this figure as a possible minimum cost by that process, depending principally upon the cost of power and of plant per unit of output, the power being considerably over one-half of the whole cost.

The above figure may be accepted but it precludes any hope that such a process will ever lead to the large use of oxygen for metallurgical or gas-making purposes. In order to accomplish these purposes oxygen must be produced at approximately one-fifth of the cost mentioned.

Mr. Murray's data about the Jefferies-Norton process is also fairly accurate so far as it goes, but he must have been badly misled with regard to the result of applying that process to the production of helium at Petrolia, Texas, where its mechanical success was proven beyond question and where it produced helium of as high a purity by a single treatment of the gas as either of the other two processes, and at a fraction of their cost. The work at Petrolia was interrupted, however, by failure to maintain the supply of helium-bearing gas for that plant and by the exhaustion of Government funds appropriated for it.

We can assert confidently in reply to Mr. Murray's strictures that the Jefferies-Norton process of distilling liquid air under pressure, and superheating the outgoing nitrogen for the recovery of power, is the only process available today which offers the possibility of obtaining oxygen cheaply enough for use in the metallurgical or gas-making industries. Practical elimination of the power cost is only a part of the problem solved by this method.—E. A. W. Jefferies.

Research on Liquid Carbon Dioxide at Mellon Institute

The Liquid Carbonic Division of the Compressed Gas Manufacturers' Association announces the establishment of an Industrial Fellowship in the Mellon Institute of Industrial Research of the University of Pittsburgh, for the purpose of classifying, studying and developing the uses for liquid carbon dioxide. The founding of this Fellowship is in accord with the desire of the members of the Association to cooperate with users and prospective users of liquid carbon dioxide, with the object of developing efficient means of applying the gas and of obtaining fundamental data bearing on its use in various industries.

In addition to conducting research work, the Fellowship will be made a clearing house of information regarding various uses of liquid carbon dioxide, and data will be kept on file for the accommodation of prospective users of this product. The present incumbent of the Industrial Fellowship is Charles L. Jones, who will be glad to correspond with anyone interested in the use of liquid carbon dioxide in industry.

A. M. Taylor, Chicago manager, General Chemical Co., has been transferred to the New York office

Louis Pasteur, 1822-1895

A Timely Resumé of the Life and Service of a Great Creative Chemist

By H. S. van Klooster
Assistant Professor of Chemistry, Rensselaer Polytechnic Institute

Louis Pasteur at the Age of Thirty

WITH the approach of the hundredth anniversary of the birth of Louis Pasteur, it may be well to recall his eminent services to humanity during his long, laborious and fruitful life.

Most chemists are familiar with Wurtz' extravagant and misleading statement that chemistry is a French science, founded by the immortal Lavoisier. Bakhuis Roozeboom, the great promoter of Willard Gibbs' celebrated phase rule, used to say that he would like to state, but only with a grain of salt, that physical chemistry is a Dutch science, founded by van 't Hoff. In the same sense it might be said that biological chemistry is a French science, founded by Pasteur.

Early Life

Pasteur was born December 27th, 1822, in the little town of Dôle, the third child of John Joseph Pasteur, a tanner by trade who had participated in the Napoleonic wars from 1811-14, in which he had attained the rank of sergeant-major and received for his courage the much coveted Legion of Honor.

In 1825 the family moved to Arbois, in the Jura district, and it was here that Pasteur received his primary and high school education. At the age of 16 he was sent to Paris to prepare himself to enter the Ecole Normale Supérieure. A strong attachment to his home town which never left him even in the days of his greatest triumphs made him so homesick that he had to return to his parents.* His strong will power and unsatiable thirst for knowledge caused him to resume his studies, so that in 1842 he was admitted to this renowned school of learning as No. 14 on a list of 22 candidates. He was so little satisfied with this result that he decided to spend another year of study before entering the school. The next year he succeeded in being accepted as No. 4 on the competitive list.

As a student Pasteur was a hard working young man who had to do a great deal of tutoring on the side to pay for his board and room. Among the men whose courses he followed were: Dumas, the leading French chemist of this time; Balard, the discoverer of bromine; Biot, a well-known physicist, and Delafosse, a pupil of Hauy and a noted crystallographer. In appearance Pasteur was cool and meditative, yet his inmost nature was full of undaunted enthusiasm, youthful vigor and vivid imagination, qualities that always characterize the great scientist and brilliant teacher. After three years of study at the Ecole Normale he passed his examination and became a bachelor of science as No. 3 out of 14 candidates, of whom 4 were accepted.

Early Scientific Work

The appointment as laboratory assistant to Balard gave Pasteur his first chance to tackle scientific problems. The influence of Delafosse was instrumental in directing the attention of the young doctor, his graduating thesis was presented in 1847, to crystallographic investigations. His first publication, dating from 1848, deals with the crystallization of sulphur. In the same year he succeeded in separating the optically inactive racemic tartaric acid into its active constituents, a truly great discovery which extracted from the lips of his friend and teacher Biot this impressive exclamation: "My dear friend, I have had such a passion for science all my life that this makes my heart throb."

The story of the interrelation of the different tartaric acids is a fascinating one familiar to all students of organic chemistry. Restating the facts briefly, we may say that if a solution of sodium ammonium racemate is evaporated at low temperatures, crystals of the composition, $NaNH_4C_4H_4O_6 + H_2O$, separate. On close examination under the microscope it will be found that the crystals may be separated into two classes, one class showing crystals of the type represented on the left (see Fig. 1), and the other crystal of a type which is the mirror image of the other. They are recognized by a small crystal face, indicated by cross shading on the crystals, appearing either to the right or on the left. Separating the crystals with the right-handed faces from those with the left-handed, making up solutions of the same strength, and allowing a ray of polarised light to pass through the solutions, we shall see that, in the first case, there is a deflection of the light to the right and in the other a deflection to the left over the same number of degrees. By mixing the solutions an optically inactive solution results. Pasteur immediately extended his investigations to similarly constituted acids, malic acid and aspartic acids, with like results. The relationship thus established between crystalline form, chemical composition and rotatory power paved the way for the subsequent far-reaching theory of the asymmetric carbon atom, developed by Le Bel and van 't Hoff.

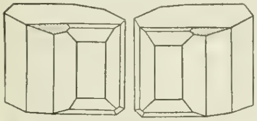


Fig. 1. Crystals of dextro- and laevo-rotatory Tartaric Acid

Appointed assistant professor of chemistry at the University of Strasburg in 1849, Pasteur continued his researches along the same lines for five years. In Strasburg he had the good fortune to meet his later life companion, Marie Laurent, the daughter of the Rector of the University, himself a distinguished chemist. A courtship of only two weeks fixed his choice and led to a most happy and devoted union of two kindred souls.

Fermentation Research

In 1854 followed his transfer to Lille as Professor of Chemistry and Dean of the newly created philosophical faculty. Here Pasteur began his monumental researches on fermentation. The change from crystals to ferments, subjects so unlike in appearance at first sight, was quite natural and logical for a man like

---

*To his friend, Jules Vercel, Pasteur explained his nostalgia by saying: "If I could only smell the tannery, I should be cured."

Pasteur. His creative thought merely extended the theory of molecular dissymmetry to the constitution of the universe. A simple laboratory experiment was the immediate stimulus for taking up the study of fermentation processes. A piece of a tartrate crystal was dropped into a saturated solution of the salt and after a while it was noticed that the crystal was rebuilt. Pasteur considered this the healing of a wound with similarly constituted matter. He also knew the changes brought about in tartrates by fermentation and supposed that these might be due to the activity of microscopic living cells.

Bio-Chemistry

Thus Pasteur entered a field where many noted investigators had earned a reputation, viz., Gay-Lussac, Cagniard-Latour, Schwann, Helmholtz, Liebig, to mention only a few. His preliminary researches were carried out in the sugar factory of Bigo and continued in Paris after his appointment as administrative head of the Ecole Normale in 1857. As the result of his painstaking work, extended over a number of years, he proved that all fermentations are due to the presence of living cells,* differing in characteristics and in mode of living. The alcoholic fermentation is brought about by one kind of ferment, the lactic acid fermentation by another and so on.

Another discovery of paramount importance was the existence of two kinds of bacteria: those for whose existence oxygen is necessary (aerobic); and those for whom it is fatal (anaerobic). A long struggle, involving various experiments made under different circumstances, resulted from Pasteur's fight against the doctrine of spontaneous origin of life, *generatio spontanea,* which was supported vigorously by the French naturalist, Pouchet. Pasteur had the satisfaction of being able to disprove all the assertions of his adversary. No microscopic living cells ever appear in an aseptic medium; all germs ever produced derive their existence from a pre-existing germ. In spite of his epoch-making discoveries, it was not until the end of 1862, after two unsuccessful attempts in 1857 and 1861, that Pasteur was accorded recognition as a French scientist of the first rank by being elected a member of the Académie des Sciences.

His rising fame attracted the attention of the wine growers, brewers and vinegar manufacturers of France, and they induced the illustrious scientist to study the factors affecting the quality of wines, beers and vinegars. Pasteur ascribed the great damages annually done to these industries to the activity of special micro-organisms. In the case of vinegar, he found that alcohol is transformed into vinegar by the growth of a germ called *Mycoderma aceti* or mother of vinegar. By using healthy cultures of this organism excellent vinegars are produced, and the rule-of-thumb long prevailing in this industry was thus eliminated.

In the case of wine, Pasteur's experiments proved that such diseases of wine as "tourne," "amer" and "graisse" were due to special microbes. Having tried at first different antiseptics, without avail, however, Pasteur finally hit upon heat treatment as the best method of preventing these diseases. Thus was reversed the old adage of the Father of Medicine, Hippocrates: "What medicine does not cure, iron (i. e., the knife of the surgeon) cures; what iron does not cure, fire cures," which obtained new significance under the safe guidance of Pasteur. Heat treatment, known as "pasteurizing," has become a household word and is applied on a large scale throughout the world. The value of Pasteur's discoveries for the industries was estimated by Huxley at a value exceeding the war indemnity of 1871, and yet Pasteur never commercialized his discoveries by taking out patents. The glory and the satisfaction of work well done for the benefit of the people was for him a greater compensation than money ever could afford.

The disaster which befell the silk growing region of the South of France and entailed an anual loss of over 50 million francs, impelled Pasteur to devote six long and difficult years to the study of the dreaded silk worm disease called "pébrine." During this period Pasteur lost his father and two daughters and suffered himself from an attack of paralysis. He had to fight against the indifference, stupidity and hostility of those whose pecuniary interests were involved before his verdict was universally accepted, namely, the elimination of all diseased worms and eggs and the cultivation of eggs from healthy adults.

The war of 1870 was a terrible shock to Pasteur, who was an ardent patriot,* and in a letter addressed to the medical faculty of the University of Bonn, he requested to have his name stricken from the rolls as an honorary Doctor of Medicine in protest against the annexation by Germany of Alsace-Lorraine.

Contagious Disease

Progress from the study of fermentation to the study of contagious diseases for Pasteur was inevitable. As he said himself on being elected a member of the Académie de Médicine in 1873: "Are not the researches I have carried on for seventeen years, in spite of all the efforts they cost me, the outcome of the same ideas, the same principles, backed by incessant labor, under always new circumstances? The best proof that an investigator is right, is the uninterrupted fertility of his work." And thus we arrive at the last, the most brilliant achievement of his life, the one which left the deepest impression on the world: the successful fight against contagious diseases by means of vaccination.

In 1877 appeared his first communication on the anthrax disease, which exterminated thousands of cattle every year. Two fundamental discoveries stand out clearly: one, the relation between the contagious disease and the presence of pathogenic microbes in the body of the animal, which cause the disease; and two, that by the cultivation of these microbes under certain well-defined conditions they are made less virulent, and instead of being a poison, they act as a vaccine (antidote). These two discoveries were successfully applied not only in the case of anthrax, but also in those of chicken cholera and hydrophobia.

Pasteur being his researches on hydrophobia in 1880 with the assistance of his pupils Chamberland, Roux and Thuillier. He demonstrated, first of all, that the center of the disease was in the brain. Being unable, however, to detect the microbe of the disease and without the means to cultivate the microbe in suitable liquids, Pasteur conceived the ingenious idea of propagating the deadly virus, obtained from the brain matter of rabid dogs, from rabbit to rabbit until a maximum of virulence was obtained which reduced the time necessary to develop the disease to seven days. The next question that came up, viz., how to change the virus into vaccine, was solved by the observation that the virulence of the brain matter was decreased by exposure to air and became completely inoffensive after standing two weeks. On applying the vaccin-virus to healthy dogs and to those bitten by rabid dogs, it was found that the first were immune and that the others acquired immunity by inoculation.

---

*[illegible] that the enzymes produced by the living cells are responsible for the fermentation processes.

*Pasteur once expressed his views on patriotism in the following words: "If science has no country of its own, the scientist must have one to which he can ascribe the influence which his works may have in the world."

The first anti-rabies treatment on human beings was performed on an Alsatian boy who was treated successively with vaccines of increasing virulence as the days passed by. After two months of great anxiety for Pasteur, no symptoms of rabies developed, and the child was saved. The second victim was a shepherd boy of 15, whose treatment began a week after he had been bitten by a rabid dog. This boy was saved and, it may be said in passing, functions now as janitor of the Institute Pasteur in Paris. Hundreds of cases have been treated since then by the method of Pasteur with complete success, the only failures being those where the victims were brought in three weeks or later after the accident.

Institute Pasteur

The discovery of the hydrophobia vaccine was the crowning event of a scientific career that extends over a period of more than 40 years and resulted in the creation of the celebrated Institute Pasteur for which in a few months' a sum of over two and a half million francs was collected by popular subscription. It was formally opened on November 14, 1888, in the presence of galaxy of distinguished auditors. For seven years, Pasteur watched the continuation of his work in this new splendidly equipped building under the able leadership of Emile Duclaux, his best beloved pupil, assisted by a staff of brilliant collaborators, such as Roux, the present director, Yersin, Metchnikoff and others.

Pasteur's seventieth birthday was made the occasion for a glowing tribute by his colleagues throughout the world in recognition for his wonderful work. Three years later he succumbed after a severe attack of uremy. Such was the life of Pasteur, a great scientist, an inspiring teacher, a devout Christian, a hero, who (to quote the words of Duclaux), had conquered the world and whose glory had not cost a single tear.

Pasteur's Philosophy

Pasteur's philosophy of life may be summed up in these memorable words, as true today as when he uttered them:

> "Two opposing laws seem to me now in contest. The one, a law of blood and death, developing each day new modes of destruction, forces nations to be always ready for the battle. The other, a law of peace, work and health, whose only aim is to deliver man from the calamities which beset him. The one seeks violent conquests, the other the relief of mankind. The one places a single life above all victories, the other sacrifices hundreds of thousands of lives to the ambition of a single individual. The law of which we are the instruments strives even through the carnage to cure the wounds due to the law of war. Treatment by our antiseptic methods may preserve the lives of thousands of soldiers. Which of these two laws will prevail, God only knows. But of this we may be sure, that French science in obeying the law of humanity will always labor to enlarge the frontiers of life."

Bismarck, the Iron Chancellor of the now defunct German empire, remarks, in the closing chapter of his autobiography:

> "A lover of peace, a benefactor to his people, and a civilizing agent does not, as a rule, influence the Christian nations of Europe so deeply and so inspiringly as one who is ready to make victorious use of the blood and treasure of his subjects on the battlefields. Louis XIV and Napolen, whose wars ruined the nation and in the end had little result, have remained the pride of the French, and the more homely services of other monarchs and governments remain thrust in the background. If I picture to myself the history of the European peoples, I find no instance in which honorable and self-sacrificing care for the peaceful prosperity of the nation has had a stronger power of attraction for the sympathies of the people than martial glory, victorious battles and the conquest of even rebellious territories."

Who shall deny the truth of this statement? Of the many thousands who visit Paris each year, few fail to visit the tomb of Napoleon, but who pays homage to the glorious life work of Pasteur and spends a few moments at the grave of the illustrious Frenchman who has saved more lives than Napoleon destroyed?

At the close of the Great War the world is ready to forget its ghastly horrors and is eager to erect hundreds of monuments to the fighters, living and dead, in order to commemorate and perpetuate their works of destruction. Few in number and little known are the shrines erected to the benefactors of mankind. When the youth of all lands shall be taught and shall learn to revere and emulate the heroes of peace like Pasteur instead of the heroes of war like Napoleon, then and then only may the world look forward to a future when wars shall be no more.

References; Vallery Radot, La Vie de Pasteur; Emile Duclaux, Histoire d'un esprit; Roux, L'oeuvre médicale de Pasteur; Keim-Lumet, Les grands hommes, Pasteur; Sir H. E. Roscoe, Louis Pasteur, Encycl. Brit, 11th Ed.

Production of Sulphuric, Nitric and Mixed Acids

In its report of the manufacture of sulphuric, nitric, and mixed acids in 1921, the Census Bureau shows a production in value of $20,529,000, a decrease of 34.8 per cent from the 1920 output. These acids are also produced to a very considerable extent by establishments primarily engaged in the manufacture of other products: Sulphuric acid by manufacturers of fertilizers, explosives, chemicals in general, and petroleum refineries; and nitric and mixed acids by manufacturers of explosives and chemicals in general. Hence the production here reported is not to be taken as representing total production. The table shows for 1919 the percentage which the production of establishments primarily engaged in the manufacture of these acids constituted of the aggregate production reported for all industries. Corresponding figures for 1921 are not available:

	1921	1919	Per Cent. of Total Production, All Industries	Per Cent. of Decrease
Cost of materials	$9,714,000	$15,857,000		38.7
Value of products	$20,529,000	$31,470,000		34.8
Value added by manufacture	$10,815,000	$15,613,000		30.7
Sulphuric acid (basis 50° Be)—				
Tons (2,000 lbs.)	1,457,500	1,685,300	50.6	13.5
Value	$15,332,700	$18,113,000		15.3
Average value, ton	$10.50	$10.75		
Nitric acid—				
Tons (2,000 lbs.)	2,110	3,150	16.2	33.0
Value	$363,700	$536,700		32.2
Average value, ton	$172	$170		
Mixed acid—				
Tons (2,000 lbs.)	16,400	28,200	60.7	41.8
Value	$1,316,000	$2,671,500		50.0
Average value, ton	$30	$95		

Of the 35 establishments reported in 1921, 5 were located in New Jersey; 5 in Pennsylvania; 4 in Ohio; 3 each in California and New York; 2 each in Maryland and Virginia; and 1 each in Alabama, Arkansas, Colorado, Connecticut, Ilinois, Kansas, Massachusetts, South Carolina, Tennessee, Texas and Utah. New Jersey, the leading State in the industry in 1921, produced 27 per cent. of the total value of products in that year.

To Promote Standardization in American Industry

Report of the Committee on Foreign Commerce and the Revenue Laws of the Chamber of Commerce of the State of New York

A MOVE towards much greater standardization in American industry has been under way for a number of years. An important body in this movement is the American Engineering Standards Committee, which is composed of representatives of the leading engineering societies in the United States, and also representatives of the U. S. Departments of Agriculture, Commerce, Interior, and of the Navy and War Departments. Not only is the United States Government co-operating in this movement, but also a number of national standardizing bodies in the leading foreign nations.

Subjects of Standardization

This Committee on Foreign Commerce and the Revenue Laws is especially interested in the success of this movement owing to its great bearing on exports of American merchandise.

Among the various subjects in which it is being attempted to apply scientific principles of standardization are the following:

a. Definitions of technical terms used in engineering work, specifications, and contracts.
b. Specifications for materials.
c. Methods of tests, especially acceptance tests for materials and apparatus.
d. Dimensional standardization to secure interchangeability of supplies; for example, screws, nuts, and bolts.
e. Dimensional standardization to secure the inter-working of parts, and of inter-related apparatus, made or assembled by different manufacturers, such as shafts, pulleys, etc.
f. Safety codes to secure uniformity in requirements for safety in apparatus and equipment, and in industrial processes.
g. The limitation of the number of types, sizes and grades of manufactured products — an exceedingly important and far-reaching subject.

Advantages of Standardization

Among the great economic and industrial advantages which will result from a more general application of scientific standardization can be enumerated the following:

1. It enables buyer and seller to speak the same language, and makes it possible to compel competitive sellers to do likewise.
2. In thus putting tenders on an easily comparable basis it promotes fairness in competition, both in domestic and in foreign trade.
3. It lowers unit costs to the public by making mass production possible, as has been so strikingly shown in the unification of incandescent lamps and automobiles.
4. By simplifying the carrying of stocks it makes deliveries quicker and prices lower.
5. It decreases litigation and other factors tending to disorganize industry, the burden of which ultimately falls upon the public.
6. It eliminates indecision both in production and utilization, a prolific cause of inefficiency and waste.
7. It stabilizes production and employment by broadening the possible market, and by making it safe for the manufacturer to accumulate stock during periods of slack orders to an extent which would not be safe with an unstandardized product.
8. By [illegible] it decreases selling expense, one of the largest problems of our economic system.
9. By concentrating on fewer lines it enables more thought and energy to be put into designs so that they will be more efficient and economical.
10. By bringing out the weight of true facts in order to determine what is best, and to secure agreement on moot questions, it acts as a powerful stimulus to research and development—and it is thus in decided contrast to crystallization resulting from fixity of mental attitude.
11. It is one of the principal means of getting the results of research and development into actual use in the industries.
12. It helps to eliminate practices which are merely the result of accident or tradition, and which impede development.
13. By concentration on essentials, and the consequent suppression of confusing elements intended merely for sales effect, it helps to base competition squarely upon efficiency in production and distribution and upon intrinsic merit of product.

It is obvious that standardization as outlined above would be of great benefit not only to our foreign trade, but also to our domestic industrial welfare.

Thirteen Points Demanded of Du Pont Men

In a recent address before the students of Princeton University, Col. William C. Spruance, a vice-president of E. I. du Pont de Nemours & Co., discussed the requirements set forth in the du Pont employment blanks. He said

"There are certain characteristics which corporations and employers want their men to possess, and certain policies and principles which they desire them to follow and with which many of you may not be familiar. Here is a more or less typical presentation of this phase of your problem. There are thirteen desirable personal characteristics which will be found to be valuable assets. I have called them 'Crecco-Splaths,' which is a word coined from the first letter of each of the thirteen when arranged in the following order:

Co-operative. None can succeed alone; success is the sum total of the successes of all the members of any organization minus their failures. Give and take assistance; be willing to help, and open to suggestion; eager to try any new idea or scheme that offers a possible advantage.

Resourceful. Don't be afraid of difficulties, nor dismayed by temporary setbacks; show backbone and persistence to overcome obstacles.

Economical. Guard against waste, be saving of time, effort and materials and suggest more economical methods to your employer.

Careful. Avoid loose methods in the office or on the road, or recklessness in field or mill operations.

Courageous. Have the courage of your convictions, and give your real opinion when asked, even if it seems to be on the unpopular side. He who sidesteps responsibility reveals unfitness for responsibility.

Obedient. Each employe is a private or officer in an industrial army. By following instructions whole-heartedly and explicitly, you will qualify as an executive.

Systematic. United, efficient work is possible only through system. Systematize your own work, study all instructions, and religiously follow the system in effect.

Progressive. Be modern, keep up-to-date; those in a rut or likely to fall into one are not wanted.

Loyal. Recognize the mutuality of interest of your employer and yourself.

Aggressive. Brains and energy are wanted; *pushers* who insist on results and have the physical and mental qualities to produce them.

Temperate. Conserve your brain and body by reasonable and proper habits so as to maintain always a high standard of efficiency. Carousing, late hours, and fast living soon result in elimination.

Honest. All other qualifications fail if this is lacking.

Sincere. Flatterers, traducers, tale-bearers, or traitors are not wanted. No criticism of any employe, officer, or competitor is desirable that may not be honestly made face to face and for the intended benefit of the accused."

The Chemical Exposition

IT is due to the chemical and allied industries generally, and particularly to those concerns which have participated in past expositions and which now are uncertain as regards patronage of this educational enterprise, that the present working at cross-purposes be checked, and that the fog of criticism of methods and results of past shows be dispelled by sound counsel for future presentations of progress in the science, art and business of chemistry.

The Independent Movement

As set forth in October CHEMICAL AGE, dissatisfaction with the methods and results of the management of past chemical shows came to such head that numerous prominent exhibitors and men keen to promote chemical industry encouraged Mr. Adriaan Nagelvoort, a well-known chemical engineer experienced as a former associate of the present exposition management, to formulate plans whereby the Chemical Show could be made to reflect coordinately the spirit of chemistry as the backbone and basis of our economic system and the general good-will of chemical industry, the plans necessarily to be predicated on the Chemical Exposition as the enterprise of the industry itself, and not as heretofore as a financial venture of an "alien" corporation.

Accordingly Mr. Nagelvoort, with the substantial encouragement of numerous prominent exhibitors and of many well-known business chemists, had drawn up as a form of government a constitution and by-laws to guide the management of a cooperative enterprise whose cost of operation would be what the exhibitors wished to make it and whose administrative personnel would embrace representatives of classified groups of exhibitors selected by themselves, and which would constitute the Board of Directors. Thus two claimants for the patronage of exhibitors came into the field.

Plans of the Salesmen's Association

Shortly thereafter the Salesmen's Association of the American Chemical Industry by its secretary, George T. Short, assumed the responsibility of directing opinion in the industry on this subject by such recommendations as its investigation of the two show managements would make advisable. In addition to this investigation upon which it has not submitted a report, the Association circularized exhibitors with the following communication:

The Salesmen's Association of the
American Chemical Industries
Office of the Secretary
135 William Street, New York

Gentlemen:

As an exhibitor at the Chemical Exposition, you must be interested in the proposals for two such exhibits.

The president of the Association has appointed a strong committee to sift the claims of both managements and to report back their findings with recommendations. Both managements have expressed their willingness to meet with this committee and lay their facts before us.

We feel that it would be a fatal mistake to attempt two shows, and it is the purpose of this Investigating Committee to determine fairly which management offers the best promise of success and constructive benefit. The committee hopes to mature plans which will make a single Chemical Exposition of greater direct benefit to the makers of chemicals and the manufacturers of chemical apparatus and supplies.

We, therefore, invite you to place before the committee any facts having a bearing upon this subject. We will welcome your criticism of either show plan and most especially your suggestions for the future.

We are undertaking this work on your behalf, believing that some disinterested body should take the initiative, and we will appreciate your prompt cooperation.

George S. Short, Secretary.

To this letter we replied as follows:

Dear Mr. Short:

In reply to your undated circular letter as regards the disposition of the dissatisfaction with which the Chemical Show closed, kindly permit us to say:

Our understanding of the situation is that there is not primarily a project for two expositions so much as there is a determined effort to have this enterprise conducted by the exhibitors. What we have is, on one hand, the determination of a group of exhibitors to organize and maintain, as a cooperative enterprise of the chemical industry itself, its own chemical exposition; and, on the other hand, the determination of the International Exposition Company not to lose its control and profits of the Chemical Exposition enterprise.

The position of your organization in the promotion of the movement for a Chemical Exposition as a cooperative enterprise of, by and for the chemical industry should be clear and well-defined, and not contribute, as we interpret this letter, to a further muddling of the situation.

The concerns which are encouraging Mr. Nagelvoort to create his organization of exhibitors are a "disinterested body" that already has "taken the initiative." The only measure of self-interest that can be attributed to this disinerested body arises out of the wishes and welfare of the industry itself, as is plainly set forth in the constitution and by-laws of Chemical Industries Exposition.

The attitude of your organization should be one of encouragement to this disinterested body which already has taken the initiative, and not to represent itself as another disinterested body seeking initiative on behalf of chemical industry and supply manufacture when this initiative already has been taken. What is wanted now is action, and not a continuation of talk on a subject thoroughly well threshed.

Whether or not there will be two efforts to conduct a show in 1923 will be determined largely by the prompt elimination of the present uncertainty, to which you can contribute materially by the encouragement referred to.

Chemical Industries Exposition combines all interests represented by a governing body selected from the various groups, and thereby removes the dissatisfaction that certainly would follow from sole management by a single group.

October 10, 1922. Editor, CHEMICAL AGE.

A Third Claimant for Consideration

Three weeks later 4,000 copies of the following letter were sent to the chemical and allied industries by the Exposition Committee of the Salesmen's Association of the American Chemical Industries:

The Salesmen's Association of the
American Chemical Industries
Office of the Secretary
135 William Street, New York

Two rival Chemical Show managements are seeking the support of the industry. This Association is convinced that two Chemical Shows mean failure for both, and we have appointed a committee which is investigating the rival claims.

With one big Chemical Show as a nucleus, we believe a "Congress of Chemistry" can be held periodically that will be of tremendous practical benefit to every branch of the industry.

A Chemical Week can be planned with so great an exposition and so interesting a program and with so many associations and societies meeting in conjunction with it that it would be an event which every man in American chemistry would have to attend and whch every newspaper in the country would report.

Our Exposition Committee is working on these plans, and it wants the help of every forward-looking man.

Would such a Chemical Week be worth while? What suggestions can you offer for its success? How can united support be won to this plan? What kind of program would you peronally like to see worked out?

We thank you for your prompt reply to this personal invitation for your criticisms and suggestions.

William S. Haynes, *Drug and Chemical Markets*,
Chairman, Exposition Committee.

To the Exposition Committee of The Salesmen's Association

To Mr. Haynes' letter we here reply at some length in the reasonable expectation that a frank discussion of various aspects of the subject mentioned may serve to crystallize opinion in a way to hasten the elimination of the uncertainty as to whether there will be two Chemical Expositions or one or none in 1923.

With the advent of a third claimant for consideration, we believe that further discussion of the project of a Chemical Exposition independent of the International Exposition Company, not only adds to the uncertainty as to the outcome of the enterprise, but unjustly works to the annoyance of the only organization which, despite criticism from numerous sources, has shown capacity to influence discordant elements in the industry, to say nothing of its experience in the conduct of a Chemical Show. The independent movement had such numerical strength as to make it formidable if it had capacity for coordination and to which your organization could have contributed materially, but inasmuch as you have decided to promote an exposition enterprise as an independent association project, instead of allying yourself with either one or the other prior claimants for consideration, we believe that the peace of mind of the industry demands that your efforts be abandoned and that such constructive suggestions as your letter may incite be turned over to the International Exposition Company.

The belief that two shows mean failure for each is so spontaneous and general that the formal expression of this belief as the conviction of your association is supererogation. You should have announced promptly the conclusions of your investigating committee as to the respective merits of the prior claimants instead of holding them in abeyance to float your own efforts to develop a kind of exposition about which you are so uncertain that you have to go to the people for suggestions. In our discussion of this subject we are animated only by the desire to bring to the surface that plan of procedure which in its development, management and results will be most effective as an educational instrumentality to promote the welfare of chemical industry.

The patronage of the Chemical Exposition has been preponderantly that of chemical equipment, accessories and supplies. You can not dissociate from the minds of men who make these things that the Chemical Show primarily is a market place in which to sell them. The patronage of manufacturers of chemicals is influenced more by a desire to promote chemical industry and hence if no business can be traced to this cooperation to make the show a success the disappointment is not so keen as to create criticism. The makers of commodities who use as raw materials the finished products of chemical manufacture are closer to the ultimate consumer who has no interest whatever in the enterprise of the two former classes of exhibitors, beyond a childlike curiosity.

You will agree that you can not run a Chemical Show without money and that those who preponderantly supply the wherewithal look upon the attendance of the man in the street as a nuisance, and that in customary exposition practice, such tangible, concrete display of chemical equipment, accessories and supplies as have marked the dominant note in preceding shows, is necessary to draw the technical crowd. Prominent men in this field have declared that there is nothing in what they make or in business done through the show that warrants an extensive display every twelfth month; that they are drawn into it more because "the other fellow is" than because of any corresponding benefit, as a result of lack of organization whereby common knowledge could influence their action. The above observations are submitted in partial explanation of the rut of monotony of attraction into which the show management has got and of the complaint of many that "its the same old show," and to introduce our detailed consideration of your questions.

A Chemical Congress

The American Chemical Society holds a "Chemical Congress" twice a year under such conditions as to convince many that once a year is enough, and in such widely separated places as will afford the most convenient and least expensive opportunity for the membership of different regions to attend.

As we all know, this is not a "popular" conclave. To add a third meeting when two are being considered as one too many opens the door to such inadvisability as to compel discussion of the character of work of such proposed "Chemical Congress." The meetings of the various satellite societies of ceramists, textile colorists, electro-chemists, oil chemists, fertilizer chemists, chemical engineers, paper technologists, etc., usually are associated either with those of affiliated trade organizations or are determined by the industrial attractions of regions, which may be inspected by the members. It is, of course, practicable to assemble many of them in New York as a side show to the Chemical Exposition, but of such doubtful desirability as will occur readily to their respective memberships.

This phase of the management of the Chemical Exposition has been marked by degeneration, notably in 1922. We appreciate the difficulties involved in making what some have called "chemical vaudeville" an outstanding educational feature in an environment where the billows of propaganda beat unmolested and where New York City itself as an attraction has any show in it beat to a standstill.

We believe John Dorr had the right idea when he expressed his doubts as to whether conditions call for a Chemical Show every year. In addition to this conviction, which is entertained widely in equipment manufacture, is the preference of many chemical manufacturers for the specialized expositions where they meet a hand-picked crowd, and whose patronage of a general show is influenced by a laudable desire to "sell chemistry" regardless of any business done. Furthermore, the acceleration of opinion in ways to make this chemical Chautauqua an attractive feature of the Chemical Show is an admission that the show itself has deficiences. Just as repetition of sensation flows into satiety, so a thing done oftener than is needed to be done brings that sterility of suggestion of ways to make it novel.

Winning United Support to a Chemical Congress

It is the conviction of many chemists that the one way to win united support for a Chemical Show is to make it the enterprise of the industry itself, to make it the industry's institution in contra-distinction to an enterprise whose success or failure depends upon the commercial astuteness of its management in handling the industry or the individuals who have acquired influence in the politics of the industry.

Chemical politicians; the professional propagandists in chemistry; the group that profits from the subsidiary graft of the Chemical Show; institutions that batten on the unorganized helplessness of those who have things to sell, and who would be disadvantaged by such concerted action as would enable the latter to dominate the situation, want an exposition every twelfth month and, accordingly, are fertile in exaggeration of conditions that they claim call for it; but many of that element of the patronage whose members make possible the Exposition, viz., the equipment, accessory and supply manufacturers, see nothing in peace-time chemical industry that warrants such disturbance of their business routine as was thought to be a part of the enthusiasm and excitement of war, but which was entered upon readily because of the novelty of the enterprise and the profits of the period.

The fact of the matter is that the Chemical Show as an annual proposition does not reflect the business sense of this element without whose support it cannot exist, but those represented by the chemical bally-hoos and the professional cheer-leaders in chemistry, believe that an annual Chemical Exposition is necessary to national salvation, and so an institution of great potentialities is being run into the ground. To propose to save the main show by increasing the attractions of the side show and to appeal to the public for "freaks" for the latter exhibit, illustrates the extremities into which it was inevitable that a "forced" institution would fall.

Do not your colleagues and yourself see, with a show staged consistently with conditions in the industry whose progress it is intended to illustrate, that what would be effective as an ancillary attraction would not deteriorate with unwarranted frequency of presentation? And so we find such efforts as yours to develop novelty therein that it may reflect justification for the exposition itself every twelfth month. With the exposition enterprise in the control of the industry, i.e., in the hands of exhibitors themselves, there would result that frequency and character of exhibition which would eliminate the dissatisfaction perennial and inseparable with management concerned solely with exhibition regardless of its commercial desirability or educational necessity.

Separating the side show from the main tent as a distinctive enterprise under the management of men already engaged with the segregational activities of their respective societies, doubtless will be welcomed by the International Exposition Company, but the suggestions properly should go to it, for just as we concluded the above comment we received from Dr. Charles H. Herty the following statement:

To Exhibitors at Previous Chemical Expositions:

The undersigned Advisory Committee of the National Exposition of Chemical Industries urges the American chemical and allied industries, as represented by exhibitors at previous expositions, to support the Ninth National Exposition of Chemical Industries.

Grave problems confront the chemical industry, and its future success depends upon united effort. Obviously the distribution of forces between competitive expositions would be disastrous. Furthermore, there are those whose interests are contrary to the interests of the American chemical industry, and they are watching closely for opportunity to widen any apparent breach in our ranks. The present management has always conducted a *national* exposition of chemical industries, and will continue to do so. This is a definite policy, adopted with the full approval of the Advisory Committee. We feel that the national character of the exposition has been productive of a fine spirit among exhibitors and has created a distinctly favorable public impression.

The significance of the chemical industry has never been presented in more tangible form than at these annual exhibitions, and the necessity for their continuance is emphasized by plain evidences that public opinion has not yet been fully awakened to the part which chemistry contributes to the national welfare. The unsympatehtic attitude of bankers and investors, the inadequate protection accorded the industry by legislators, and the general lack of knowledge regarding our industry on the part of the thinking public bear striking testimony to the need for further public presentation of the story. No other single event of the year approximates the value of the exposition in focussing public attention upon the chemical industry.

Starting in 1915 as an experiment of doubtful outcome, the Chemical Exposition achieved immediate success. This has given rise to persistent rumors of inordinate profits accruing to the management. A sub-committee of the Advisory Committee has recently given the books of the International Exposition Company close scrutiny. The charge of profiteering has no foundation whatsoever.

Recently there has been considerable loose talk and vague criticism of the exposition and its management. No formal complaint has been brought to the attention of this committee, despite determined efforts to seek out the sources of dissatisfaction. Minor criticisms have occasionally arisen, and these have been readily corrected. More exhibitors have signed contracts for the 1923 exposition than in any previous year at the corresponding date.

The chemical industry has been passing through a period of severe depression and uncertainty, which naturally reflected itself in the 1922 exposition. The management recognizes the problems to be faced in producing a thoroughly satisfactory exposition in 1923. They have always been ready to accept practicable suggestions when offered by the committee or its individual members. Committee members have been freely consulted, and we are confident the management will continue to do its utmost to comply with every suggestion made for the betterment of the expositions. This committee has, in turn, always been available to exhibitors as a means of directing the general policy and the specific character of the exposition.

The Advisory Committee recommends that the American chemical and allied industries give their undivided and wholehearted support to the established National Exposition of Chemical Industries. The next meeting of the Advisory Committee will be held on November 14, 1922, at which time consideration will be given to specific plans for improvement of the 1923 exposition. The committee will welcome suggestions from exhibitors.

Chas. H. Herty, *Chairman*, President, Synthetic Organic Chemical Manufacturers' Association
Raymond F. Bacon, Consulting Chemical Engineer
L. H. Baekeland, President, The Bakelite Corporation
J. V. N. Dorr, President, The Dorr Company
Henry B. Faber, National Aniline & Chemical Co., Inc.
Bernhard C. Hesse, Chemist, General Chemical Company
Henry Howard, President, Amer. Inst. of Chem. Eng.
H. E. Howe, Editor, *Jour. of Ind. & Eng. Chem.*
Percy C. Kingsbury, General Ceramics Company
A. D. Little, President, Arthur D. Little, Inc.
H. C. Parmelee, Editor, *Chem. & Metall. Eng.*
R. P. Perry, Consulting Chemist
Cabl G. Schluederberg, President, Amer. Electrochem. Soc.
Edgar F. Smith, President, American Chemical Society
John E. Teeple, President, Chemists' Club
T. B. Wagner, Consulting Chemist
David Wesson, Southern Cotton Oil Company
M. C. Whitaker, President, U. S. Industrial Chemical Co.

Nagelvoort Takes Issue with Herty

The next stage of the development of this narrative was the receipt November 12th of the following communication from Adriaan Nagelvoort:

Adriaan Nagelvoort
50 East 41st Street, New York

To Exhibitors at Previous Chemical Expositions.

You have received recently a letter from Dr. Charles R. Herty purporting to be signed by all the members of the Advisory Committee of the National Exposition of Chemical Industries, urging you to support the International Exposition Co. in its management of a 1923 Chemical Exposition.

The general encouragement of the movement to conduct a chemical show that would be the industry's own enterprise controlled by the exhibitors themselves was the result of dissatisfaction with the management which the Advisory Committee now commends and for which it now solicits your support.

The fourth paragraph of Dr. Herty's letter says that rumors of inordinate profits are baseless and that a sub-committee has given the books of the International Exposition Co. "close scrutiny." More than "close scrutiny" of its books by any members of the Advisory Committee will be required to dispel this rumor; only an independent audit of the eight shows will do this.

Let us compare the 1921 Bronx Show and the 1922 Grand Central Palace Show as follows:

	Bronx 1921	G. C. Palace 1922
Rental area—sq. ft.	$145,000	20,000 1st floor—$2 50,000 upper floors—$1½
Price per sq. ft.	$2.00	
Income Floor Rentals	$290,000	$115,000
Rental of Building	$7,500	$25,000
Booths and Decorations at 25c per sq. ft.	$37,500	$17,500
Office and Traveling Expense and Advertising	$15,000	$15,000
For Managerial Salaries and Net Profits, Excl. of Commiss. & Concessions	$230,000	$57,500

In the above figures no credit is given for income from concessions such as furniture rental, electric connections, service of all kinds, restaurant, soft drinks, etc.

In the fifth paragraph of Dr. Herty's letter he alleges "loose talk and vague criticism of the Exposition and its management" and that "no formal complaint has been brought to the attention of this Committee." This paragraph of Dr. Herty's letter plainly is misrepresentation fully appreciated by those familiar with the situation. Not only has the Advisory Committe never interested itself in the management of the Exposition but has displayed such indifference to its reputed responsibilities as to merit censure. Attached is copy of a legal opinion submitted in substantiation of this statement.

AN OPINION OF A MEMBER OF THE NEW YORK BAR

I have before me copy of a contract, which covers employment and the creation of a trust fund, dated October 4, 1916, entered into by the International Exposition Co., by its then president and general manager, respectively, Rich. G. Hollaman and F. W. Payne, and Adriaan Nagelvoort and Charles F. Roth, whereby it is agreed by the Company, as party of the first part, and Nagelvoort and Roth, as parties of the second part, that the said parties of the second part, after certain conditions precedent, shall receive, in addition to other stipulated amounts, 25 per cent. of the net profits of the Chemical Show of 1917, and that 10 per cent. of the remaining net profits "will be turned over through you," i.e., Nagelvoort and Roth, "to a fund decided upon by the Advisory Committee of the Exposition."

This contract of 1916 for the 1917 show is a duplicate of the contract of 1914, covering the 1915 show, under the terms of which the parties of the second part turned over to the Advisory Committee for the creation of a fund, the sum of $238.16, and is a duplicate of the contract of 1915, covering the 1916 show, under the terms of which $738.00 was available to apply to this fund. The amount applicable to this fund under the 1916 contract for the 1917 show is not set forth.

I am advised that the Advisory Committee for the 1915 show was apprised ot this fund of $238.16, of which there were and are trustees, by virtue of their relations to the International Exposition Co. and in pursuance of said contract, and decided that such sum should be kept intact and to the credit of the fund. The amount, viz., $738.00, accruing under the 1915 contract for the 1916 show was not turned over to the Advisory Committee, but was kept by the International Exposition Co.

As I understand, the object of this fund never was specified. Its disposition plainly was in the hands of the Advisory Committee; it could do with it as it wished. It could renounce any responsibility in regard to it and so allow it to lapse to the donor; no purpose or beneficiary ever was specified to give form and substance to the trust relationship.

The Advisory Committee of the 1915 show and the International Exposition Co., acting under the 1914 contract, recognized this fund and the former accepted the responsibility of trusteeship for its disposition, which act constituted the consideration for its service to the donor, the International Exposition Co., aside from the "opportunity to promoe chemical industry."

Members of the Advisory Committee who have knowledge of the contracts hereinbefore set forth, until they have renounced responsibility of trusteeship carry the burden of responsibility for the disposition of this fund, and by the terms of the contract they are the sole arbiters of the disposition of this fund.

If the members of the Advisory Committee allow this fund to lapse by indifference, as it appears they have done, to the pecuniary advantage of the [illegible] the allotment of this fund for such use as they might decide [illegible] the consideration for their service as members of the Advisory Committee, while their unbusinesslike conduct [illegible] they severally or collectively have [illegible] legal right [illegible] in the opinion of the writer, is assignable.

[illegible] a proper procedure would be for a member or members of the Advisory Committee who have served from the time of the first contract to demand the fulfillment of this provision [illegible] in the enforcement of [illegible]

I [illegible] of a chemical exposition in [illegible] and managed by repre[illegible] I had experience, was [illegible] management and [illegible] exhibitors.

I [illegible] for their cooperation [illegible] exhibitors that I [illegible] in the establishment of a [illegible] chemical [illegible] exhibitors and [illegible] to the service and possibilities of chemistry. This subject will continue to be an open one until settled right.

ADRIAAN NAGELVOORT

Notwithstanding that the Chemical Show is conducted primarily for the profit of a private corporation, it is a trade institution and therefore should be the subject of public discussion unrestrained by fear of reprisal of its management. Those who interest themselves in the subject know that the Advisory Committee is a perfunctory appanage whose activity is confined to individuals who have axes to grind. The others bask in the sunshine of the publicity of their position and have had as much to do with the management of the show as has the gilded figure on the prow of a vessel with the boat's navigation. If this statement is untrue the present situation never would have arisen.

Standardized Laboratory Apparatus

An auspicious example of standardization in chemical manufacture is presented by the work of a committee of the Manufacturing Chemists' Association of the U. S., comprising: Chairman E. C. Lathrop, E. I. du Pont de Nemours & Co.; J. M. Weiss, Barrett Co.; R. M. Meiklejohn, General Chemical Co.; C. L. Jones, Solvay Process Co.; L. C. Drefahl, Grasselli Chemical Co., and L. C. Johnson, National Aniline & Chemical Co. The report of this committee is entitled, "Standard Specifications for Laboratory Apparatus Adopted by the Manufacturing Chemists' Association of the U. S." (49 pp., 8 x 10), and covers the commonly used laboratory apparatus of glass and procelain, including thermometers.

In as much as the types of apparatus used in making tests and analyses, particularly empirical ones, influence greatly the accuracy of the results, it is believed that if the same instruments were adopted and used by manufacturing chemists generally, not only can difference in analyses of materials bought and sold be more easily adjusted, but that substantial economies can be effected by the elimination of types widely variant in serviceability and cost. The committee enumerates the following benefits that it believes will come from standardization of laboratory apparatus:

1. That the number of kinds, types and sizes of certain instruments will be greatly reduced, so that much larger quantity production will result in those instruments adopted.
2. That more suitable instruments can be manufactured on a quantity production scale at a price not to exceed some of the less satisfactory instruments previously offered.
3. That quantity production should result in direct economies, both in manufacture and carrying stocks, thus assuring more rapid deliveries and lower purchase price.
4. That universities and colleges knowing the types of instruments required by industries will be able to familiarize their students with these before they enter on industrial work.
5. That such standardization and resultant economies should assist the American apparatus manufacturer to better meet foreign competition.

Manufacturing chemists are urged to familiarize themselves with these specifications and to confine their purchases to the types and sizes that the committee believes should become standard. The committee intends to extend its work to embrace standardized beakers, hydrometers and other laboratory equipment. Copies of the report can be procured from John I. Tierney, Secretary, Manufacturing Chemists' Association, 610 Woodward Building, Washington D. C. The price is $1.50.

J. Thompson Brown, who has been with E. I. du Pont de Nemours & Co. since 1903, has been appointed general manager of the explosives department to succeed the late Charles A. Patterson. His early work was in plant engineering and in operation responsibilities at the high explosives plant. He is a graduate of Virginia Polytechnic Institute and studied at Cornell.

Chlorine in Paper Making

Will the Manufacture of Pure Cellulose from Wood and Straw Provide a New Outlet for Chlorine?

By Ismar Ginsberg, B.Sc., Chem Eng.

A SOLUTION of common salt yields caustic soda and chlorine when the electric current is passed through it. This simple reaction is the basis of the electrochemical manufacture of caustic soda. In the early days of the industry the fact that there was simultaneous production of chlorine gas in equivalent amount to caustic soda was not considered disadvantageous as there was no difficulty in its disposal by conversion into bleaching powder. As the industry grew with the increased demand for caustic soda, the demand and uses for chlorine gas did not increase in anything like the same proportion, and the problem of getting rid of the excess production of chlorine gas became pressing.

Today the American electrolytic caustic soda industry is confronted with this problem. It is very desirable to increase the production of caustic soda by electrochemical processes, but it is equally essential to find a way of disposing of the chlorine production. Great development has been made in the use of liquid chlorine, but this has not been sufficient to absorb the large amount of the gas manufactured. There have been found a few new uses for chlorine, but by far the greatest part of the consumption still is in the manufacture of bleaching powder, used chiefly in the textile and paper industries, and for the purification of water. The gas is very corrosive, destructive of vegetation and it has proven a very difficult matter to find new applications for it. The plan of allowing it to escape into the atmosphere is hardly feasible, due to the damage that it can do, even if such a procedure could be countenanced from the economic standpoint.

Chlorine for Paper-Making in Italy

In Italy, where a good proportion of the caustic soda is made electrochemically, the same problem has existed. Italian technologists have been paying considerable attention to this matter and recently have used chlorine to produce pure cellulose, well-suited for the manufacture of paper, from various raw materials, such as poplar wood, hemp and hemp refuse, straw, esparto grass and other vegetable fibers. This process is now being operated successfully on a large scale by the La Elettrochimica Pomilio Company in Naples. This company is concerned primarily with the electrolytic manufacture of caustic soda and was having considerable difficulty in getting rid of its excess chlorine, when the new process for making cellulose with the aid of this gas was developed. The wood pulp is made on the premises and its manufacture does not require expensive equipment nor great technical knowledge. It affords the company a means of utilizing a product, which it could not dispose of in the market, and of making a profit on the undertaking, for the cost of the wood cellulose by use of chlorine compares favorably with wood pulp made in the regular manner. The ease with which the new process was installed, the similiarity between Italian and American conditions in the electrolytic soda industry, and other advantageous aspects of the project warrant its description. It will be apparent that the same procedure may be followed by electrochemical plants in this country with the same results.

The use of chlorine to make pure cellulose from wood and other vegetable fibers is by no means new. Cross and Bevan indicate its use for this purpose and it has been used generally as a reagent in the laboratory to isolate pure cellulose from such raw materials. But the commercial application of the gas and its successful development into an industry, which can compete with wood pulp made by the standard methods of manufacture, is new. The first installation, made by the Pomilio Company, was in 1919 and had a capacity of 10 tons of cellulose per day.

The chemical part of the process consists of three stages, viz., (1) treatment of the cellulose materials with a dilute solution of caustic soda, (2) partial decomposition with the aid of gaseous chlorine and (3) washing with a weak alkaline solution. The mechanical treatment of the fibers is the same as in the other processes of making paper pulp. The preliminary treatment with a dilute solution of caustic soda softens the woody fibers, so that the chlorine gas may have a better chance to get into the internal structure of the fibers and attack the ligno-cellulose contained therein which it does much more readily than it affects the pure cellulose. Consequently, the ligno-cellulose is chlorinated and rendered soluble, leaving behind the pure cellulose.

The details of the method were worked out at the Pomilio plant with the result that by proper control of temperature, pressure and concentration, rapidity of the chlorination can be fixed within proper limits to confine the action of chlorine to ligno-cellulose only, leaving the pure cellulose unattacked. Washing with dilute alkaline lyes serves to remove all the converted ligno-cellulose, still contained in the product, so that the final result is a paper pulp of the highest grade of purity.

Economic details of the method also have been worked out and indicate that the chlorine process possesses a decided advantage over other pulp-making process from the cost standpoint. For the treatment of one hundred kilograms of crude poplar wood, there are required the following materials: 28 kilograms of moist chlorine gas, 16 kilograms of coal or an equivalent quantity of any other suitable fuel, 6 kilograms of chloride of lime and 5 kilograms of caustic soda ($NaOH$) in 5-percent. solution. These figures will vary with the proportion of cellulose in the wood; the greater this proportion, naturally the less of these materials will have to be used.

Advantages of Chlorine

The quantity of chlorine or caustic soda used in the process can be varied to suit current market conditions. The above figures represent the maximum use of chlorine and the minimum use of caustic soda. This practice is desirable when the chlorine market is glutted with excess production, and the caustic soda sales are brisk. If the situation should change, it is easy to alter the operaiton so that more caustic soda and less chlorine gas is consumed. This possibility of varying the conditions of the operation is a decided advantage and emphasizes the economy of the method.

In the place of caustic soda an equivalent quantity of quicklime may be used. Just as good results are obtained in this way. The Pomilio plant produces its 10 tons of paper pulp every 24 hours with a force of 50 laborers.

Compared with the caustic soda process of making paper pulp, the chlorine process has important economic advantages not only in the consumption of raw materials but in the reduced amount of equipment. The usual rotary or fixed digesters are replaced by cylinders for soaking the wood with the dilute alkaline lye, and concrete autoclaves, provided with suitable inlet and outlet pipes and valves for controlling the flow of reagent, for the treatment with chlorine. There is a great reduction in power needs, to wit, about one-tenth of the power used by the caustic soda process. Extensive apparatus to recuperate spent caustic soda lyes is not required. The bleaching operation is far less costly, due to the fact that both the time of the operation and the amount of bleaching powder consumed are reduced; treatment with chlorine gas naturally exerts a considerable bleaching action itself. Water consumption is approximately the same in both processes. There is by no means so great a quantity of spent liquors to be handled and recuperated as in the soda process. It is necessary, however, to provide a tank for the neutralization of acid liquors runoff from the chlorination autoclaves. The best manner of handling these liquors is to allow them to flow over beds of limestone. Another important advantage of the chlorine process is that it permits the same plant, with a few minor mechanical changes, to be used for the manufacture of paper pulp from different kinds of raw materials. A one-story building, covering about 1,500 square meters in area, is sufficient to house a complete installation for the manufacture of 10 tons of paper pulp per day by this process. This does not include storage space.

The saving in raw materials effected by use of the chlorine process can be seen from the following data. For every 100 kilograms of chemical pulp from esparto grass, there are consumed the 222 kgs. of esparto, indicating a yield of 45 per cent.; 150 kgs. of coal; 22.22 kgs. of carbonate of soda; 26.66 kgs. of lime; 17.75 kgs. of chloride of lime; and one liter of sulphuric acid. The actual amount of carbonate of soda used is 44 kgs., there being a 75-percent. recovery. The figure 22.22 kgs. is arrived at by estimating the value of the recovered salt as one-third that of the new carbonate.

Corresponding figures for the manufacture of sulphate pulp from wheat straw show that 100 kgs. of pulp require 320 kgs. of straw, 180 kgs. of coal, 20 kgs. of carbonate of soda, 32 kgs. of sulphate of soda, 34 kgs. of lime, 20 kgs. of chloride of lime, and one liter of sulphuric acid. By the chlorine process 100 kgs. of the finished product require 266 kgs. of straw, 28 kgs. of chlorine, 15 kgs. of coal, 6 kgs. of chloride of lime, and 5 kgs. of caustic soda. These are figures from actual operation.

A considerable saving in raw materials by the chlorine process is obvious. The coal consumption is reduced to one-tenth; the caustic soda consumption to one-quarter and the chloride of lime consumption to one-third. The yield of pure cellulose is increased by 20 per cent. No lime need be used. To counteract these reductions it is necessary to take account of the added expense of 28 kgs. of chlorine. The price of chlorine varies with its origin; when used directly from the electrolytic cells it is but a fraction of that of liquefied gas in steel cylinders. Whatever this price may be, there is no question but that it is far more than counterbalanced by the decreased consumption of coal and caustic soda. Besides these economies in raw materials, the chlorine process has to its credit a 50-percent. reduction in the cost of labor and another 30-per cent. reduction in overhead and amortization cost, due to the much lower cost of initial installation. There is the additional advantage of a 20-percent. increase in the yield of paper according to the chlorine process. These figures, while applying to industrial conditions in Italy, will not differ materially when translated into American terms..

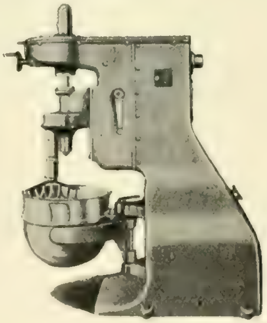
From the above date it is obvious that cost of production by means of chlorine will be less, and at any rate it will be no greater than that of the old paper-making process.

By the customary processes it is necessary to use rather high-grade raw materials in order to obtain high-grade papers. By the chlorine process the raw material may be of the lowest grade, but the paper made by it is of fine quality and can be used as writing paper.

That American paper technologists are alert to the possibilities of the chlorine process is shown by the extensive investigations of one of the largest American sulphate-paper makers engaged also in chlorine-caustic soda production. That American raw materials analogous to those used in Italy for paper manufacture by the chlorine process are of inferior commercial availability, by no means detracts from the possibilities of the process in American paper-making practice, for it may be applied to the woods used in the prevailing processes.

A Handy Mixer

Mixing is the basic chemical procedure. The infinite variety of products thus made call for a corresponding variety and size of utensil, according to the kind and mass of materials used and to the control of contact of ingredients, temperature and pressure necessary to produce the product desired. Here is shown a type of mixer developed to satisfy the requirements of cleanliness, ease of operation, durability and adaptability to many products of chemical manufacture.


The Strite Mixer.

The motor, with variable speed transmission, is placed accessibly in the base of the frame, where it is protected from dust, moisture and dirt. The adjustable head not only provides for the elevation and depression of the agitator shaft to which various designs of mixing blades may be attached, but permits a movement in the mass in the kettle independent of the rotary motion of the agitator. The kettle-holder is supported on a hinged frame which enables the kettle and holder to swing clear on either side, with attachment to release the kettle for removal or dumping.

The mixer is 5 ft. high and occupies a floor area of 2 x 3 ft.; the frame and all exposed parts are made of a non-tarnishing white aluminum alloy which takes a high, permanent polish. The kettle may be of this material or of any material demanded by the nature of the ingredients of the product. The ease of control of agitation and handling of the kettle adapt the machine to a wide range of mixing or emulsifying action as required for condiments and foods, cosmetics and shaving cream, salves and pastes, and numerous other products that are made in masses of 4 to 25 gals. The mixer is made by the Strite Machine Co., South Norwalk, Conn.

Industrial Alcohol Production and Uses in the Philippines

By Howard Irving Cole
Chemist, Bureau of Science, Manila

THE largest source of raw material for the production of alcohol in the Philippine Islands is the saps of the various native palms; of these, the sap of the nipa palm is most used. Another large source of alcohol is the molasses obtained as a by-product in the manufacture of sugar from sugar cane. Various cereals, cassava, bamboo, and other cellulose materials are also potential sources of alcohol. In fact, the potential sources of alcohol in the Tropics are illimitable, as can be readily appreciated by any person who has traveled in tropical countries. The following table shows the quantity and kind of raw material used in the production of alcohol in the Philippine Islands and the amount of alcohol produced during 1919 and 1920.*

	1919		1920	
Source of alcohol	Quantity used	Proof alcohol produced	Quantity used	Proof alcohol produced
	Liters	*Liters*	*Liters*	*Liters*
Nipa sap	57,770,157	5,887,208	51,730,608	5,148,315
Coco sap	3,500,159	456,980	4,309,671	525,643
Molasses	11,004,256	6,778,878	18,058,566	9,078,297
	Kilos		*Kilos*	
Hard molasses	....	....	1,373 925	924 888
Cane sugar	501,347	273,377	516,979	326 844
Grain	2,775	481	3,996	1,921
	Liters		*Liters*	
Others	18,728	16,688	16,206	13,275
Total production	....	13,413,612	....	16,019,183

In 1910, 93 per cent. of the total amount of alcohol and alcoholic beverages produced in the Philippine Islands was distilled from the sap exuding from palm trees. In 1920 this value had fallen to 35.4 per cent., due mainly to the increased use of molasses. The utilization of palm saps at present is confined to a few small areas. There are great tracts well situated for exploitation which have not yet been touched.

Molasses

Among the waste products utilized for the manufacture of alcohol, cane or black-strap molasses ranks first. This product has been used for the manufacture of West Indian rum for more than two hundred years, but the utilization of molasses in large quantities for the production of industrial alcohol is a development of the last few years. For the manufacture of alcohol molasses far surpasses any other material except palm saps in the ease with which it can be manipulated. Some 300,000,000 gallons of molasses are annually available in the West Indies. Tank steamers carry this material to the distilleries located in New York, Boston, Baltimore, New Orleans, and other manufacturing centers. In 1920, 110,000,000 gallons of molasses were used for the production of industrial alcohol in the United States.

The Philippine Islands sugar crop of 1921 totaled 552,027 short tons. The molasses weight is about 25 per cent. of the weight of the sugar produced. This gives an annual production of 23,000,000 gallons of molasses, of which only 20 per cent. was utilized for alcohol. Practically no alcohol was made at the centrals, the molasses being transported to the distilleries, mostly in or near Manila. Molasses is at present being run to waste in some sugar centrals because of a lack of market for it. Negros Island alone produces annually 8,000,000 gallons of molasses. Production undoubtedly will be largely increased in the future.

It takes 2.5-3 gal. of molasses, depending chiefly on the percentage of sugar in the molasses and on the efficiency of the plant, to make 1 gal. of 190° proof (95 per cent.) alcohol. At the latter conservative figure the present annual supply of molasses in the Archipelago is a potential source of approximately 7,800,000 gallons of alcohol. Besides the fermentable sugar, cane molasses also contains valuable salts which can be utilized for fertilizer. In fact, the price of molasses is based largely on its fertilizing value. As far as the writer can ascertain no attempt is being made in the Philippine Islands to recover the nitrogen, potash, and phosphorus compounds contained in the lees in the manufacture of alcohol from molasses. Theoretically, if the ash of the burned bagasse and the salts of the molasses are returned to the soil the latter suffers no loss, as the sugar formed consists of carbon, hydrogen, and oxygen, which can be obtained from air and water.

Fermentation of the Molasses

The methods of fermentation of molasses in the Philippines are crude, with consequent low efficiencies. There is no distillery using modern yeast-culture machines and very few in which the dilution of the wort, the addition of acid and sulphate, the stopping of the fermentation at the highest alcohol content, etc., are scientifically controlled. Brill and Thurlow* have shown that sterilization of the molasses solution or the use of good water increases the efficiency markedly. Also the dilution of the molasses to a definite density (about 16.5 Brix) is essential. The addition of 2 grams of sulphuric acid and at least 0.4 gram. of ammonium sulphate to every liter of ferment will increase the percentage of alcohol produced. The use of pure yeast culture is probably the greatest factor in obtaining the highest possible efficiency. They recommend 1 part of pure yeast-fermenting wort to 100 or 150 parts of ferment. The dilution of the molasses may be decreased by using the Molhant process of accustoming the yeast to fermenting in more highly concentrated solutions, with a consequent saving in heat necessary for distillation. J. Magné cites the following figures with reference to the yield of alcohol according to the process employed:

Yield of Alcohol from Molasses According to Process Used

Method of fermentation:	Yield of alcohol, per cent. theoretical	Absolute alcohol per 100 pounds fermentable sugar.	Molasses 50 per cent fermentable necessary for 1 gallon absolute alcohol
		Gallons	*Gallons*
Spontaneously in presence of yeast	40-60	2.9-4.1	3.5-5.4
Using compressed yeast	50-75	3.6-5.5	2.8-4.2
Using antiseptics	70-85	5.1-6.2	2.5-3.0
Operating with pure yeast	85-95	6.2-6.9	2.2-2.5

---

*From a paper in *The Philippine Journal of Science*, Vol. XXI, July, 1922.

*Philip. Journ. Sci. § A 12 (1917) [illegible]

It is quite possible to obtain a yield of 85-90 per cent, yet 75 per cent is considered good practice in the Philippine Islands. Any improvement in the methods of fermentation and distillation of molasses would mean an increase of revenue to the Islands and larger profits to the manufacturer.

Miscellaneous Raw Materials

Any starch or cellulose material can be converted into alcohol by proper treatment; consequently, the raw materials for the production of alcohol, in the Tropics at least, are practically inexhaustible. Bamboo, cassava, the various palms, wood waste (sawdust), etc., can all be utilized; however the nipa sap, and waste molasses available will more than meet the demand for the next few years.

The yields of alcohol from various sources, as given in the following table, are what may be expected in large-scale production:

Approximate Yield of Alcohol from Various Sources

Material	United States gallons of 95 per cent alcohol per short ton
Sugar molasses	70
Sorghum stalks	13.5
Wheat	100
Barley	75
Potatoes	21.5
Sweet potatoes	37.5
Cassava	42
Bananas	14
Sawdust (soft woods)	21.5

Inorganic Sources of Alcohol

The commercial production of alcohol from inorganic materials is a recent achievement. The general method involves the hydrogenation of acetylene to form ethylene, which is then dissolved in sulphuric acid; this mixture, containing ethyl hydrogen sulphate, is diluted and distilled, alcohol being given off. A cheap source of power is necessary to make such a process a commercial success. A plant for the production of alcohol by this method is now in operation in Switzerland. The process is not a feasible one for the Philippine Islands at present.

Alcohol and Alcohol Mixtures As Fuels

Although the application of alcohol as a fuel for internal-combustion engines dates back more than two decades, it is only within the last four or five years that the problem has assumed practical importance. This is due to the enormous increase in the use of automobiles and the world-wide application of crude oil to transportation. The powers of the world are even now engaged in a struggle to monopolize the available supplies of crude oil, for our present-day commerce is dependent very largely upon an adequate supply of oil. The pioneer experimental work on the production of an efficient alcohol engine has been completed.* It has been found that in order to use alcohol efficiently, the following alterations in the present type of engine are necessary:

Increased Compression.—Alcohol is more efficient in engines of low piston speed and long stroke. This is due to the slower flame propagation of alcohol vapor in comparison with gasoline vapor and its ability to stand higher compression (180 pounds per square inch) without preignition.

Preheating of [illegible] Alcohol Vapor.—Alcohol will not vaporize at ordinary temperatures. The preheating necessary can be readily done by utilizing the exhaust, with an electrical contrivance for starting from the cold.

Reduced Water-Cooling Circulation.—Alcohol does not give out as much heat in burning as gasoline, but needs high cylinder temperatures for efficient working.

Increased Jet Orifice of Carburetor.—An alcohol engine needs the jet orifice enlarged so as to increase the fuel supply about 50 per cent.

Carburetor Floats.—Either a metal float or a cork float having a baked coating of boiled linseed oil should be used instead of a shellac-coated float, as shellac is soluble in alcohol.

It is thus readily seen that alcohol cannot immediately replace gasoline. A fuel which can be used in the present type of engine is necessary to tide over the transition period during the change from gasoline to alcohol engines. Such a fuel is a mixture of alcohol with a more volatile substance, such as benzol or ether.

Alcohol Mixtures

Mixtures of alcohol with other substances have been in use for some time. The mixture most used in Europe is one of alcohol and benzol. The use of benzol makes the fuel dependent on a coal-tar industry, and such countries as South Africa, Australia, South America, the Philippines, etc., would have to import their benzol. Consequently there has been developed in South Africa and in Hawaii a mixture of alcohol and ether; since the ether is made from the alcohol, its manufacture is practically independent of any other industry.

In South Africa "Natalite" has come into wide use due to the scarcity and the high cost of gasoline during the World War. It has been patented in all countries throughout the world. This mixture contains 55 per cent of rectified alcohol, 44.9 per cent of ether, and 0.1 per cent of ammonia. In 1918 over 255,000 gallons of Natalite were produced from molasses in South Africa. At the present time the largest factory is at Merebank, Natal, the capacity of which has been increased to 2,000,000 gallons per annum.

In 1918, due to the scarcity of gasoline in Hawaii, there was developed by Mr. Foster, of the Maui Agricultural Co., a motor fuel very similar to Natalite which has been used very successfully in the place of gasoline. It consists of a mixture of 55.55 per cent alcohol, 42.78 per cent ether, 1.11 per cent kerosene, and 0.56 per cent pyridine; that is, 40 gallons of ether are added to 60 gallons of Formula No. 3 [to each 100 gallons ethyl alcohol add 5 gallons sulphuric ether, 2 gallons benzine (kerosene), and 1 gallon pyridine].

With either of these mixtures, either being very volatile, the engine can be started even more easily than with gasoline. The pyridine or ammonia is added to neutralize any acids that might be formed in the fuel or in the combustion of the fuel, and it also serves as a denaturant.

These mixtures compare very favorably with gasoline in efficiency. That these fuels can even now compete with gasoline for airplane engines in the United States, where gasoline costs less than one-half what it does in the Philippines, is demonstrated by the United States Post Office Department in its airplane mail service, as reported by R. B. Tunison. Its tests show "a greater increase in number of miles per gallon, an increase in power and a very marked saving in the quantity of lubricating oil used." These tests also proved that there was much less carbon formation when using alcohol fuel than when using gasoline, and the number of forced landings due to fouled spark plugs was reduced to the minimum.

[illegible]

These alcohol mixtures have been thoroughly tested, and they compare very favorably with gasoline.[1] The mileage obtained is equal or superior to that obtained with gasoline; there is no carbon deposit left in the cylinder; the acids formed are neutralized by the pyridine or ammonia present, hence there is no corrosion; there is less tendency toward knocking, resulting in a smoother-running engine; the heat of combustion is lower, hence the engine is less liable to overheat; in case of fire it can be extinguished with water; an engine can be started more easily from the cold than with gasoline; there is less fouling of the spark plugs and lower consumption of oil.

Foster[2] points out that the addition of substances that would neutralize the acids formed by the explosive combustion of the alcohol-ether fuel has incidentally often resulted in retarding the production of corrosive compounds within the fuel itself. He states in his United States patent No. 1,384,946:

> "It is obvious that the production of a successful synthetic fuel for internal combustion engines involves not only the problem of protecting the engine from the products of combustion, but the far more involved problem of protecting the fuel itself from destructive action and the fuel storage and supply system from the deleterious effects resulting from such auto-destructive action of the fuel."

The use of ammonia as a neutralizing agent in alcohol-ether mixtures is open to the great objection that ammonia is very volatile.

Alcohol-Ether Motor Fuel Production Costs

Alcohol distilleries now operating can easily make the alcohol-ether motor fuel by simply adding an inexpensive ether still and the requisite storage tanks to their present equipment. The ideal location for such a plant, however, is not in Manila, but at the sugar centrals or in connection with a nipa swamp, thus eliminating the high cost of transportation of the raw materials and fuels. In the former case the waste steam from the central can be utilized to run the distillery; in the latter, the mangrove wood can be utilized as fuel.

An economical plant should have a daily capacity of at least 1,200 to 2,000 gallons of motor fuel. Smaller plants cost relatively more to erect and to operate.

> A plant with a daily capacity of 1,200 gallons could be built in Hawaii in 1919 for $30,000, exclusive of buildings, boilers and fuel storage tanks. The cost of operation exclusive of molasses and steam will not exceed 10 cents (U. S. currency) and should not exceed 7 cents.[1]

A distillery of this size would require at least six fermentation tanks, with a total capacity of at least 100,000 gallons; four yeast tanks, with a total capacity of 15,000 to 20,000 gallons; a yeast-culture machine; an alcohol-rectifying still, 1,200 gallons daily capacity; two ether stills and scrubbers, 350 gallons daily capacity; and the necessary storage and mixing tanks. The capacity of the storage tanks would naturally depend upon shipping facilities, market, etc.

Another estimate[2] on cost figures for an alcohol motor-fuel plant erected in the Philippines, is as follows:

Estimated Cost of Alcohol Motor Fuel Plant Producing 1,000 Gallons Per Day

BOILER ROOM:	Dollars
1 75-horsepower steam boiler	1,572.00
Oil and water feed pumps, general fittings, etc.	2,000.00
FERMENTING ROOM:	
1 molasses scale	400.00
2 7,500-gallon mixing tanks	388.00
12 6,500-gallon fermenting tanks	2,164.00
3 200-gallon yeast tanks	212.00
3 250-gallon yeast tanks	58.75
2 pumps	400.00
STILL ROOM:	
1 modern copper continuous still, producing alcohol of 96-97 per cent in one operation	6,000.00
2 1,000-gallon charging tanks	115.00
1 1,000-gallon singling tank	57.50
DENATURING WAREHOUSE:	
2 2,000-gallon metal receiving tanks	440.00
Denaturant storage tanks	250.00
1 500-gallon denaturing tank	100.00
1 air compressor	200.00
ETHER ROOM:	Dollars
1 modern sulphuric ether generator	3,500.00
1 1,000-gallon supply tank	57.50
1 ether storage tank, metal, 1,000 gallons	144.00
FINISHED MOTOR FUEL STORAGE ROOM:	
2 5,000-gallon tanks	368.00
1 1,500-gallon mixing tank	58.00
1 pump	200.00
GENERAL:	
All piping throughout plant	2,000.00
Miscellaneous expense	1,815.25
BUILDINGS:	
Greatly varying as to type of construction, preparation of site, location, materials, etc., estimated at	12,500.00
Grand total	$35,000.00

> These figures are evolved from the result of practical experience in the erection and operation of numerous distilling plants and of particular experience in the erection of one motor fuel plant. The equipment figures and supply costs are based on current prices at San Francisco, Calif., plus freight charges delivered to Manila, P. I. While the technical and engineering side of * * * [these] figures have been very carefully worked out allowance must be made in the items of labor, insurance, overhead, depreciation, etc. Those items being governed by local conditions will vary somewhat. The figures used are reasonable and conservative. In the item of buildings also there can be some variance; however, the figure used is great enough to take care of the general type of buildings that would be called for in this kind of plant. Under favorable conditions this sum would be somewhat less, whereas under conditions where there would be much excavation or grading to be done, the estimated figure would be exceeded. No allowance has been made for ground site, it being assumed that such a plant would be erected on plantation premises so that this would not be an item of expense. The item of molasses also is not charged for two reasons, first because molasses at the raw sugar mill is generally considered a practical waste, and second, because of the fertilizing value of the spent slop.

Ether Production

The ether can be made for less than 10 per cent over the cost of alcohol.* There are, however, two more recent methods for manufacturing ether from alcohol which utilize the alcohol in the vapor phase. A purer product and higher yield are obtained at a lower cost than by the lead-still method.

The first method[1] consists of superheating the alcohol vapor to the right temperature, then passing it through a chamber containing lead balls over which sulphuric acid is allowed to drop slowly. Transformation to ether occurs instantaneously, the alcohol being in contact with the sulphuric acid only momentarily. The ether vapor is then passed through a washer containnig caustic soda and then to a rectifying column to separate it from water and alcohol. About 3 pounds of acid and 14 pounds of soda are required for every 100 pounds (13.9 gallons) of ether made. The process is being used successfully in the Natalite factory at Merebank, Natal.

The second method is a catalytic process and eliminates the use of sulphuric acid and caustic soda. The alcohol is passed through a superheater and then over alumina, acting as a catalyst. The temperature of the vapor and catalyst must be kept constant at about 200° C.

If the temperature rises above 200° C., ethylene is formed. By passing the outgoing vapors through tubular heat exchangers to heat the incoming alcohol, a small superheater is the only necessary heating apparatus; the amount of heat necessary for the conversion is less than 10 per cent of that required in the lead-still process.

---

[1] Alcohol used alone is of course more efficient than are alcohol mixtures when used in slow speed engines with high compression. *Sugar News* 2 (1921) 524.

[1] Report of the Committee on [illegible] and Utilization of By-products. Hawaiian Sugar Planters' Association (1920).

[2] Oscar Krenz Copper & Brass Works. [illegible] Sugar News [illegible] (1921) 591.

*Humboldt E. [illegible] 50 (1919) 420.

Operation Costs

The estimated daily operating cost of alcohol motor fuel plant producing 1,000 gallons per day is given by Krenz[2] as follows:

			Dollars
1934 tons average cane molasses			000.00
No. 34 66° Bé. sulphuric acid, 2.5 c per lb.			.85
No. 14 caustic soda, 5.4c per pound			.76
21 gals. benzene, 50.0c per gal			10.50
10½ gals. pyridine, $1.86 per gal			19.53
40,000 gals. water, diluting, condensing, etc., pumping cost of 10c per 1,000 gals			4.00
6½ bbls. fuel oil, $7.28 per bbl			47.32
LABOR:			
1 fermenting room man and foreman, day shift		5.00	
2 distillers, night and day shifts,	3.00	6.00	
1 denaturer, day shift		3.00	
1 ether man, day shift		3.00	
2 firemen, day and night shifts	3.00	6.00	
1 laborer		2.50	25.50
Interest at 8% on $35,000 over 312 working days, per day			8.97
Insurance on ⅓ plant value, premium $3.00 per 100 per year, per day			.11
Depreciation at 10% per year, $3,500; per day			11.21
Office expense, general overhead, etc., per day			10.00
Grand total			138.75

The above estimate shows that the cost of producing one gallon of alcohol from molasses, exclusively of the cost of molasses, is 13.87 cents. Mr. Foster computes the cost of operation to be 7 to 10 cents, exclusive of molasses and steam. The fertilizer recovered from the less practically covers the cost of the molasses. In the Philippines alcohol-ether motor fuel can undoubtedly be made to yield a handsome profit when sold at 25 to 35 cents a gallon.

In Natal the original Natalite company showed a profit of 38 per cent in 1920. The original 5-pound shares of the parent company are now quoted at 105 pounds Sterling. When Natalite was placed on the market in Natal at 52 cents, gasoline was selling for 1.50 dollars. Today there are several centers where gasoline is entirely off the market.*

In the Philippines, during the World War gasoline reached as high as 3 pesos a gallon. The present price is 1.15 pesos in Manila. At a price considerably lower than this, alcohol motor fuel can more than successfully compete with gasoline.

The present annual supply of molasses in the Philippines is a potential source of some 7,800 gallons of alcohol. The consumption of gasoline for 1920 was 9,160,000 gallons. Therefore, the Philippine Islands could almost supply its own needs for motor fuel by simply utilizing its present supply of molasses for such production. Since the nipa sap available is many times as great as the molasses supply, and is an even cheaper source of alcohol, the country is in a position not only to supply its own needs, but to export as well.

Summary

The nipa palm and molasses offer cheap and easily manipulated sources of alcohol for use as a motor fuel.

Alcohol, alone, will probably not be used as a motor fuel until a new type of high compression, slow speed engine is developed.

Alcohol mixtures today are being used on a large scale in the present type of gasoline engine with simple alterations. These mixtures offer many advantages and no disadvantages over gasoline and are more efficient than gasoline.

[illegible]

Although no alcohol motor fuel is being manufactured at present in the Philippine Islands, two distilleries are installing the necessary apparatus for its manufacture. Utilization of waste molasses and of the unlimited supply of nipa sap in the production of alcohol motor fuel would not only make the Philippine Islands independent of other countries for its supply of motor fuel, but would also constitute a very valuable addition to the industries of the Islands. Since modern industry largely depends on an abundant and cheap supply of motor fuel and since in time of war the price of imported fuel goes skyward and the supply is curtailed, the establishment of an industry supplying motor fuel from the natural resources of the Archipelago will be of immense value to the Philippine Islands.

Bankruptcy of Germany

Among the outstanding impudences of German history, since her great and nationally popular gamble on the war brought a result so disastrous to German speculators, is the official proposal of what calls itself the German government for an international loan of $500,000,000. There is a callous audacity about the appeal which is so unbelievable as to be almost convincing, on the old theory that extremes meet. It is not that $500,000,000 is an impossible sum. German capital dishonestly hidden abroad is sufficient, on the most conservative estimate, to meet that sum forty times over. It could be met twice out of the worthless paper marks fraudulently sold in America and elsewhere.

With the mark selling (for people foolish enough to buy it) at the rate of sixty for an honest cent, the following extract from the official German dispatch might be the effort of some untimely jester:

> "The German government appreciates that the ultimate success of the stabilization process depends on internal, as well as external conditions, and as the recipient of such financial relief from abroad, would undertake to institute rigorous reforms."

Every gold mark of German capital not nailed to the ground has been moved out of Germany to escape the tax gatherer. The estimate of such capital at $20,000,000,000 is probably far within the real figures. It is invested in readily realizable securities and short term loans in Sweden, Norway, Spain, the South American countries and the United States, and even in the allied countries where it can be successfully camouflaged. The money paid for German exports does not go back to Germany. It is hidden safely for the day when German reparations will be entirely cancelled.

When that fraudulent end is assured Germany will cancel her entire internal debt. She will scrap the paper mark as the French scrapped the assignats issued 130 years ago, and those were partly secured on a claim to confiscated lands, which is at least something better than what German business, German government, German efficiency, German effrontery, humorously call "honor." Germany has been bankrupt since the second year of the war, which is true of some other states. She has been fraudulently bankrupt since she signed the peace treaty, and that is a distinction exclusively her own.

That the solvent nations will seriously consider advances to this common cheat is an idea which could only have occurred to the astonishing German mind, so utterly incapable of entering into the mind of those to whom chivalry, sacrifice, solvency and fair dealing are words with a meaning. Nothing remains but a receivership without consideration for the feelings of the debtor, not for the debtor's sake but to clean out a pestilent spot on the world's surface lest it corrupt the rest.—*Wall Street Journal.*

Development of the Filter Press

By C. L. Bryden

Filtration Engineer

NO equipment used in chemical manufacture better exemplifies the principle of the growth in efficiency of construction and operation of tools now indispensable, and how little it can be attributed to any one man, than the filter press. Each improvement has invited another as the requirements of the work demanded until the most efficient form represents the aggregate ingenuity of many men. Nevertheless, in recent years special types have been evolved.

The Bag Filter

Among the first economically important filtration patents to be taken out that of Cuchet and Monfort in France and that of S. McComb, J. Smith, and B. D. Galpin in America are the ones most commonly known. The filters patented were for the rapid filtration of water and wine and consisted of cloth mediums fitted on frames and suspended in containers. The American patent differed from the French in that the filter container was closed, although nothing was mentioned about pressure being used. Needham, in England, therefore, is usually accredited with obtaining the first filter press patent, in 1828.

A little earlier in 1824 Cleveland, an Englishman, took out patents for the clarification of sugar juices through bags. In 1830 Taylor in America patented a modification of this method, which filter is still being used by some sugar companies and was used by nearly all up to a few years ago. In these filters the juice is fed through pipes to the various bags and allowed to drain through by gravity, the whole set of bags being enclosed in a container to prevent loss of heat. After each run the bags had to be removed and cleaned, which of course involves considerable time and labor.

In order to increase the rate of flow through the bags J. Kite of Vaux, England, in 1857 invented a method of forcing the juice through the bags by means of a force pump. Danek improved upon this about 1864 when he perfected in Prague a filter similar to the Taylor except that he used rigid iron or wooden frames to prevent the bags from collapsing, and employed pressure to force the juice through the bags from the outside inwards, thus reversing the method Taylor used. This same type with a few variations and operated by gravity was made by the Societe Philippe in France and by Karakowsky in Hungary a short time later, really as a result of Jelinck and Fry's method of purification of sugar juices by means of milk of lime and carbon dioxide gas, perfected in 1863. In 1858 Dr. Julius Lowe described a filter using asbestos as a filtering medium which filter could be used in filtering gelatinous and corrosive liquids. In 1860 Prof. Boettger employed gun cotton in filtering liquids which acted chemically on paper. In 1867 Dr. Gibbs used powdered glass for a filtering medium.

The Suction Filter

In 1869 Bunsen perfected a suction filter and although numerous attempts had heretofore been made to filter by vacuum he was the first to demonstrate its practicability. Gooch's crucible filter perfected in 1878 was a modification of the Bunsen suction filter. The development of the potash beds in France brought this method of filtering into prominence as leaching was the main step in manufacturing. Large false-bottomed tanks were used and into these the sludge was charged, the clear liquor being drawn off the bottom by suction. The tanks were operated until the cake or layer of solids was three, four, or more feet thick, when it became necessary, because of the lowered rate of flow and lack of room to feed in more sludge, to clean out the accumulated deposit. The only way that this could be done was for men to get into the tanks with shovels and dig it out.

The Drum Filter

The great inconvenience and expense of this method of handling led to several inventions to obtain continuous filtration, those in which a revolving drum was used being the most successful. One of the first of these was that of J. Droeshort of Paris, who in 1893 patented a revolving drum covered with a screen around which passed an endless belt. The belt passed from the drum to rolls where the cake was dried and removed and thence back to the filter drum. The Solvay Company, which took out patents in Belgium in 1896 on drum filters, constructed machines which were very successful. Although they used the same drum which had been employed for some years they did not use a traveling belt, but filtered through a medium fastened permanently on the drum, discharging the solids over a scraper as the drum revolved.

This same type is still being used by the Solvay Company for the handling of their bicarbonate of soda, both abroad and in this country. In 1903 George Moore patented the multiple compartment rotary filter, which machine allowed separation of wash water from filtrate and the application of compressed air for automatic cleaning. This development made the rotary filter, wherever the slurry was suitable for its use, the most efficient and economical machine which has so far been devised. Modifications of the Moore type now being manufactured are the Glaymorgan Rotary Filter developed in 1915, the Oliver Continuous Filter brought out in 1908, the Portland Continuous Filter brought out in 1912, and the Zenith Rotary Filter which is manufactured under the Moore patents.

The Leaf Filter

It was about this same time that Moore patented his leaf filter which found much application in the cyanide process of extraction, and is often given credit for first making possible the reclaiming of low grade ores and tailings. This filter consisted of leaves connected together and to a common header, submerged in an open tank and operated by suction. It was transferred from one tank to another for washing and discharge by means of an overhead crane and, as vacuum connection was by means of rubber tubing, it was thus semi-automatic. Butters made these leaves stationary in a tank and washed and discharged by filling and emptying the tank.

There were many other filters of the leaf type and Moore construction (differing from the bag filters) brought out about this time and it was not until the United States Circuit Court of Appeals rendered Moore a favorable decision in 1912 that the basic nature of his apparatus was generally conceded. Shortly after Moore took out his patents, one of his associates, Kelly, enclosed the leaves in a container and operated them under pressure, drawing out the leaves horizontally and in one unit for discharge. This machine because of the cake which could be built up under high pressure is widely used.

Sweetland about the same time enclosed circular leaves in a clam-shaped filter and discharged by swinging open the lower half of the press and applying air pressure to the interior of the leaves, as is done in the Moore and the Kelly.

The Rotary Filter

The Burt revolving filter, consisting of leaves fitted to the shape of a cylinder and filtering from the inside outwards, and the Burt cyanide filter, rather similar to the Kelly but with the leaves stationary and the container on an angle, with a movable head for discharge, were brought out a few years later, as were the Ridgway and Merrill filters.

The General Filtration Company in 1915 brought out a filter of the rotary type in which the drum was constructed of a composition called "filtros." This machine was particularly designed for acid solutions and is used in many acid plants.

Dr. H. B. Faber also in 1915 invented the rotary hopper de-waterer. The de-waterer as the name implies is for the de-watering of heavy crystals and is similar to a series of Buchner funnels arranged radially about a central shaft, each connected by a separate pipe line to multiple valve hub. This machine is largely used in de-watering free filtering solids of a high specific gravity.

The United Filters Corporation in 1916 began making a filter consisting of a series of discs mounted on a central shaft, suspended in an open container, connected to a multiple valve and operated by suction. This machine was for de-watering large quantities of ordinary free filtering solids.

Vallez in 1916 enclosed a series of disc filtering units in a container and employed pressure for filtering. The units were connected to a central hollow shaft and revolved during filtration in order to build up a uniform cake. They are especially successful in clarification work.

The Plate and Frame Filter

The filter press as it is known to-day, whether of the recessed plate or of the alternate plate and hollow frame design, is largely a result of the work of John Johnson of England. In the early eighties he devised some filters of the plate and frame type for his own use and these proved so successful that he entered the filter press business. Johnson later came to America and started the John Johnson Filter Company. Shriver and Co. commenced building filter presses a few years later. Their most important development is the Atkins-Shriver filter, patented in [illegible] which is a vertical type press, having arms between each plate that plow off the cake when the plates are revolved. The Sperry, Perrin, Day, Provo, Independent, Merrill, Patterson, Albright-Nell, etc., filters are all more or less alike in general construction, differing in the plate or frame design. These filter presses although expensive to operate, clumsy to handle, and imperfect in their wash, are more used than any other type of filter and in most cases the reason is that no automatic or leaf filter will handle the slurries to be filtered and give equally good results.

Water Filters

The development of water filters is usually considered a separate subject from the filters just described, and although but few types have been developed, water filters have reached a greater state of perfection and standardization than any other filtering apparatus. Sand filters of various construction have been used from time immemorial and they still form the basis for most water filtration. There are four kinds of water filters usually recognized: Slow and filters; modified sand filters; mechanical filters; and double sand filters.

The slow sand filter is the old type of graduated gravel and sand through which the water percolates, usually known as the English system. The modified sand filter usually has sedimentation tanks before it and is so constructed as to allow back washing for cleansing. The mechanical filters, called the American system, are closed containers holding sand and gravel or other medium for clarifying, and operate by pressure. They are cleaned by back washing and often have sedimentation tanks before them. The first large mechanical filter was installed in the Little Falls plant of the East Jersey Water Co. in 1902. This has proved to be very successful and since then numerous others have been installed. The double sand filter consists, as the name implies, of two sets of filters, usually of the modified sand type. It is not possible to take up here the numerous household and small water filters, except to say that practically all operate under water pressure and use some form of charcoal or paper as a filter medium.

In 1917 an attempt was made to standardize water filters. The two kinds, gravity and pressure, both have beds of coarse sand, except those having beds of coagulants, and the individual makes all give substantially the same rate of flow, so that the only difference is in material and workmanship.

Screens are used in most sewage disposal plants to take out the larger solids. They have been developed almost entirely within the past twenty years, especially abroad. There are four kinds in regular use, viz., disc screens; drum screens; horizontal screens and cone screens. Cleaning of the screens is accomplished by means of brushes, backwashing, or a combination of both.

Sprinkling filters, a rather recent innovation, are sprays which take the sewage after screening and Imhoff tank or other sedimentation and throw it in the form of coarse drops over beds of crushed stone, usually several feet in thickness. The effluent which drains off from the crushed stone beds is practically clear and is ordinarily safe to run directly into streams.

Miscellaneous Related Equipment

Hydraulic presses have been successfully used for the past fifty years to extract oils and juices where ordinary pressure would not give sufficient extraction. There has been little variation made in the general design, all depending upon squeezing between two or more rigid plates. Numerous im provements of course have been made in the actual construction, particularly in applying high pressures.

Oil extractors and moisture expellers are products of the past decade and generally consist of a tapering screw encased in a shell. As the screw moves forward in revolving, the material is carried with it, the liquid being squeezed out at the same time.

Oil filters of various kinds both for filtering the oil itself and for separating oil from water are likewise a development of the last twenty-five or thirty years. Oil filters enable oil to be purified and waste oil to be reclaimed, while separators of oil from water enable exhaust steam to be used and mean a saving of coal.

Dust collectors, such as the bag-house collector came into use to save the valuables lost in smelters and coke ovens. The great variety of gas filters, vacuum cleaners, air filters, etc., are a much later development. The invention of the turbo-generator made the filtration of air a necessity, especially during the war and as a result many improvements in filters for this use were made.

There have been numerous machines made within the past thirty years, which although not strictly filters, yet because of their application to this field, deserve mention. The Dorr Classifiers and Thickeners invented in 1904 have found great success in the mining field and recently have been introduced into industrial plants. The Cottrell system of electrical precipitation invented about fifteen years ago has largely supplanted the old bag-house collectors and has enabled fume and smoke nuisances to be eliminated. The use of zeolites for removing the hardness from water and for absorbing oil in water has proven to be very successful recently, although patents were taken out on similar processes a number of years ago; but never attained commercial success.

The foregoing is only a very bare outline of the more important filters most of those of recent development being merely mentioned, but it will give the reader a general idea of the growth of filtration up to th present time. Since there have been granted ,269 patents on filters and filtering apparatus in this country alone since the founding of the Patent Office, not including centrifuges or special machines, any attempt of this kind at filtration history necessarily must touch only upon the types which seem to have been the most basic and fundamental in filtration development.

Phenolic Electrical Insulating Material

PHENOLIC insulating materials have been introduced during the past few years for a wide variety of uses. In electrical work they are used for the same purposes for which hard rubber, sometimes called ebonite or vulcanite, has been used, i.e., for the insulating parts of electrical instruments and apparatus. The ever-increasing demand for raw rubber in other industries, however, renders it too expensive for general use as an insulating material. The cost of the raw material has increased the tendency to load hard rubber with fillers or to use reclaimed rubber. While hard rubber has a number of the properties desirable in an electrical insulating material, such as high electrical resistivity, very small power loss, and ease of machining, it has, on the other hand, certain undesirable qualities, such as low tensile strength, brittleness, high thermal expansivity, deterioration in sunlight, and because of a tendency to soften at moderate temperatures it shrinks and warps.

Composition materials using shellac, pitch, or similar compounds as a binding medium are used in the manufacture of electrical insulating material, but for most radio uses the more expensive materials using phenol condensation products as the binder have proved more satisfactory.

Phenol Condensation Products

The two essential parts of this class of material are the base or filler and the binder.

The base consists of sheets of paper, fabric, or fiber, and the binder is a phenol condensation product. Bakelite-Dilecto and Continental-Bakelite, made by the Continental-Fibre Co., Newark, Del., and Bakelite Micarta, made by the Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa., have as a binder a phenol varnish (condensation product) manufactured by the General Bakelite Co., Perth Amboy, N. J. The makers of Condensite Celoron, the Diamond State Fibre Co., Bridgeport, Pa., use a phenol varnish manufactured by the Condensite Co. of America, Bloomfield, N. J., and the makers of Formica, the Formica Insulation Co., Cincinnati, Ohio, a phenol varnish manufactured by the Redmanol Chemical Products Co., Chicago, Ill. The General Bakelite Co., Condensite Co. of America and Redmanol Chemical Products Co. are now united as branches under one organization, viz., Bakelite Corporation. The same type of phenol varnishes are used by many companies in making what are called molded materials, in which the base or filler consists usually of a powdered material instead of sheets, as in the laminated materials.

In general, this varnish is the result of the chemical reaction of any suitable hydroxyl aromatic compound, such as phenol or its homologues, and hexamethylenetetramine or a suitable equivalent active methylene body. The reaction, carried on in the presence of heat, may be stopped at any convenient point, so that the resulting resin may have any characteristic between a fusible, soluble resin and an almost infusible, insoluble resin. For use in this type of insulating material the reaction must be stopped while the resin is both fusible and soluble. The resin in this condition is then dissolved in a suitable solvent, such as alcohol or acetone, and is then ready for use as the varnish binder in the laminated insulating materials. This description of the process of manufacture of phenol varnish is not meant to be an analysis for any one kind of phenol varnish. It is a general process.

Paper, fabric, or fiber may be more or less easily impregnated or coated with a phenol varnish. If sheets of paper have been so treated and dried at a low temperature, they are ready, then, to be built into a sheet of insulating material of any practical thickness. After a certain number of the impregnated sheets have been stacked together the stack is put in a hydraulic press and subjected to pressure and heat. This heating tends to complete the chemical reaction in the varnish, which was stopped in the making of the resin to permit dissolving. The press heating tends to "turn-over" or convert the varnish to an insoluble, infusible state. The stack of impregnated sheets has now become a mechanically strong, dense sheet of insulating material.

Since paper has a grain, i.e., a unidirectional fibrous structure and a resulting greater strength with the grain, it is evident that if each sheet of paper is built into the stack in the same direction with reference to the grain, one should expect the resulting compressed insulating material to have a grain. The condition of the surface of the finished sheet of insulating material is dependent on the condition of the face plates of the hydraulic press, which are called platens. If these are polished, the sheet will have a polished surface whereas if the platen faces were unpolished, the sheet will have a dull surface. A dull surface may be polished by buffing with oil and rouge, but such a method may affect the electrical properties of the surface of the insulating material.

At some stage in the manufacture or use of the phenol varnish a dye may be added, usually black. It is quite easy to recognize the various grades of laminated materials if natural colored samples only are considered, but to know each material and grade when all samples are black requires a thorough understanding of many details. The average user of the material would have much difficulty in checking his stock if the materials or grades were mixed by him or the jobber. Furthermore, some of the retailers of these laminated phenol-methylene insulating materials fail to appreciate or know any difference in grades of a particular kind of material, so the consumer may misjudge the material by not receiving the grade best suited to his needs. The manufacturers could assist by stamping the grade designation on each sheet, but the user must always take precautions to inform himself as to what grade of material he really has.

Hard Rubber

Hard rubber is composed of crude rubber, sulphur, and usually some mineral filling compound. As previously stated, the relatively high cost of crude rubber has induced some makers of hard rubber to use reclaimed rubber or else load the new rubber with a high percentage of mineral filler. The lack of a proper understanding of this fact between the maker and the user has often resulted in unjust censure of hard rubber as an insulator. The better grades of hard rubber are made of new rubber containing no mineral filler and are free from excess sulphur.

Vulcanized Fiber

Vulcanized fiber is made of parchmentized paper. For the better grades of fiber rag base paper is used. The paper is run slowly through a warm concentrated solution of sulphuric acid or zinc chloride, the one solution being used in making fiber sheets one-eighth inch thick or less, the other solution being used for thicknesses greater than one-eighth inch. The purpose of the acid or zinc chloride is to soften the walls of the cellulose (cotton) fibers, so that when several sheets of treated paper are pressed together the fibers tend to mat and cohere. The treated paper is wound on a drum until the cylindrical tube of the desired thickness is obtained, the cylindrical tube being then cut so as to form a sheet whose width is equal to the width of the paper and whose length is equal to the circumference of the drum. The composite sheet of treated paper is then soaked in water to remove the acid or zinc chloride, dried and pressed. The term "vulcanized" is somewhat misleading. Fiber does not depend upon heat and pressure to cure it as does hard rubber.

Vulcanized fiber varies widely in both mechanical and electrical properties. The properties depend somewhat on the quality of rags used, the amount of residual sulphuric acid or zinc chloride, and upon the density of the finished product.

Comparison of Hard Rubber, Vulcanized Fiber and Phenolic Products

Hard rubber and vulcanized fiber have been used by engineers for many years. Some still find in these materials the particular property needed for their work others have felt a need for some other material but have not had sufficient information to choose that better material. Some engineers have failed to study these two materials—hard rubber and vulcanized fiber—sufficiently to use them wisely and economically. Often too little or too much has been expected of an insulating material.

The problem of the proper use of the proper insulating material has been at once facilitated and complicated by the advent of the laminated and molded phenolic materials. These materials lend themselves to many uses not satisfactorily filled by either hard-rubber or vulcanized fiber, but they are likewise used where hard rubber or fiber might better be used. The phenolic insulating materials are for many purposes not hard-rubber substitutes. They are distinctly different. It is evident that the idea of phenolic insulating materials as a hard-rubber substitute has been overworked. This tendency may well be explained on the ground that the phenolic insulating materials are really quite new and yet in a state of development. Engineers have turned to this new material but have found little data at hand to direct them in its use.

The molded phenolic insulating materials are subject to as many variations as hard rubber. There is probably not as much variation in the phenolic resin binder in the molded phenolic materials as there is in the crude or reclaimed rubber binder of hard rubber. There are many other chances for variation in the press pressure and temperature, length of curing in the presses, and kind and quality of filler. Some of the fillers used are wood flour, pulverized mica, and asbestos. The kind and amount of filler will affect both the mechanical and electrical properties.

Technologic Paper No. 216 of Bureau of Standards

When the United States entered the war against Germany, the various Government departments and private manufacturers were making demands on a few manufacturers of laminated materials of the phenol-methylene type beyond the capacity of their manufacturing equipment. It was the practice in ordering insulating material for radio and other electrical apparatus to specify, more or less arbitrarily, the use of insulating material of a certain trade name instead of specifying the qualities or properties required for the particular use in view. This condition led the War and Navy Departments and some of the manufacturers of phenolic insulating materials to seek data on the various properties of the materials.

Some of the manufacturers began to inquire into the faults of their material with a view to correcting their processes, if possible, or choosing their basic materials so that their product would receive Government approval. The result of which inquiry instituted in 1917, has been the publication by the Bureau of Standards of Technologic paper No. 216 in which has been summarized by J. H. Dellinger and J. L. Preston, physicists, comprehensive investigations of the properties of laminated phenolic insulating materials.

Cost Accounting in Chemical Laboratories

By Fred W. Feuerbacher
Accountant, Pease Laboratories, Inc.

THIS subject had very little, if any, consideration in the past. The probable reason for this neglect appears to be the comparatively small field for analytical and consulting laboratories.*

Through the long association with this field the writer has worked out an elaborate system of cost records which have proved most valuable in the determination of a fair price to clients as well as a fair return to the owners. This system produces such information as will show what work is profitable and what kinds of analytical tests are unprofitable; the reasons for the profits or losses are readily revealed after a persistent tabulation of the records.

The latter information serves to permit the preparation of sliding scale prices, *i.e.,* for one test, for two tests, for three tests, etc. It also reveals the comparative fluctuations in the costs on a given test. This variation in costs always should be treated with the utmost care, as when a worker becomes so proficient that he does not require the assistance of any of the usual factors in a laboratory, and finishes the job in record time, the owner as well as the client is entitled to a little of this efficiency in dollars and cents. The owner should weigh the costs in these cases against the reasons why that worker is proficient in making these certain tests and allow himself leeway to either the replacing of that man or the increasing of his salary. An efficient and speedy worker generally secures his knowledge by repetition principally, by use of the owners' books and the supervision and advice of his chiefs. In other words, the speed and efficiency of one worker is not the only basis for costs.

The costs when compiled in a comparative form will readily show the variations, the causes being numerous. Some of them are represented in the unfamiliarity with the methods of analysis, the necessity of preparing the apparatus for the work, the difference in wages and the necessity for accuracy and not speed. The latter case appears when there is a legal matter involved and several repeat tests are made.

The costs are based primarily on the productive amount. Between the period when a worker starts his job and when he finishes it his time is estimated and placed on a card. Each day he completes a Daily Time Report, filling in the laboratory number, work done and the estimated time required. It is impossible to accurately determine the amount of time spent on the job, as from start to finish. The reason for this being the number of jobs a worker can do at one time. Thus start one and get that job in a condition where it will work while he is away from it; in the meantime, start another, watching both at the same time.

After the worker fills in his card it is approved by the man in charge and sent to the accounting department daily. The department chiefs and assistants are given cards which permit them to record their time from start to finish. The nature of their work, which consists mainly in consultation work, permits a recording of their time accurately.

The time cards of both the workers and chiefs are then summarized by the addition of the per hour rate, and the amounts chargeable to any particular job are entered on a cost-ledger card.

The productive amount as shown on the cost ledger card is increased by its proportionate share of the overhead as determined by the distribution of overhead. Materials used are so small in comparison with the other factors that to determine the amount used on each job would cost more than the results would warrant. The total amount of materials used, as determined by a check against the inventory on the yearly basis, is charged directly into the overhead.

In the beginning it is necessary to appraise the inventory as accurately as possible; also the location of the various items as to departments. The space occupied by each department must be known so as to properly distribute the rent charges. The question of insurance can be distributed according to its risk, *i.e.,* fire—on the basis of the inventory.

The value of this work is evidenced in more than one direction. It presents a basis for setting a figure for a fair price for analytical and consulting work; a check on the comparison of costs so as to quote on large numbers of tests (*viz.,* more than one at a time); keeps a close watch on the speed and efficiency of the various workers; determines the value of unfinished work, shows a complete record at all times of the costs of promotion of prospectives; a perpetual record of the costs on contracts; and the value of the various kinds of income and their cost.

The difference in keeping these costs in a laboratory is apparent within two to three months after the installation. The operation of these records does not require any large force to keep it running and the time in preparing the cards by the employes does not in any way interfere with their regular work.

New Building of National Academy of Sciences and National Research Council

Twenty friends of science contributed money for the purchase of a block of land north of the Lincoln Memorial, Washington, D. C., on which on October 30, was laid the cornerstone of a structure which will house the offices of the National Academy of Science and of the National Research Council and provide space for an exhibit illustrative of the growth and service of science. The present structure with a frontage of 260 ft. and 3 floors is the first unit of quadrangle which will cover the entire block, and will cost over $1,000,000, provided by the Carnegie Corporation of New York. It will be ready for occupancy in the fall of 1923.

Patent Exposition

The Universal Patent Exposition Corp., A. B. Cole, vice-president, 110 W. 40th Street, New York, will conduct a "Universal Exposition of Inventions and Patents" at Grand Central Palace, New York, February 17-22, 1923, whose object will be to bring the capital of America and the inventive brain of the world together and to give all inventors full opportunity to show the public, manufacturer, merchant, capitalist and financier the possibilities for utility that lie in their inventions.

Dr. Otto Kress, formerly technical director, Consolidated Water Power & Paper Co., Wisconsin Rapids, Wis., is now with Thilmany Pulp & Paper Co., Kaukauna, Wis., in the same capacity.

---

*[illegible] 10, [illegible]

CHEMICAL
AGE

Volume 30
Number 11

November
1922

A Consolidation of
The Chemical Engineer
and Chemical Age

EDITORIAL

THE recent statement of the Advisory Committee of the National Exposition of Chemical Industries projects the subject of the maintenance and management of an exposition of chemical progress into the lap of the trade and leaves it no longer for the exclusive consideration of those who have nursed it as an enterprise for private profit. Disclosures, in the letter by those promoting the independent movement, to former exhibitors, made in answer to Dr. Herty's statement, all of which is set forth in the article on pp. 483-6, indicate that the subject has assumed such importance as to demand general consideration.

From a business standpoint, and entirely aside from ancillary educational features to promote attendance and to stimulate popular interest in chemistry, an exposition is simply an advertising medium whose value to those who pay the price and thus make the show possible is determined by results.

Dissatisfaction with these results arises, among others, from causes later mentioned; others are inherent in the character of chemical industry. Manufacturers of chemical equipment, accessories and supplies have made the show possible from its inception. That chemical manufacture has played a minor part only can be explained by an apparently poor opinion of the value of the Exposition as an advertising, i.e., a sales-promoting medium. For commentators to disparage the "Chemical" Show by calling it a "Chemical Equipment" show display little grace to those who have done the lion's share to promote chemical industry by an exposition. These men have little patience with the ill-advised suggestions of others to make the Show "popular" when what they want is "technical" attendance. The general attitude of these men is discussed in the article above referred to.

Chemical industry is a congery of industries. It admits classification into three well-defined groups, viz., (1) equipment, accessories and supplies, (2) manufacture of chemicals and (3) manufacture of commodities in which the products of the preceding groups are essential raw materials. The first group sells to the second and third groups; the second sells to the third and this group deals with the public. The Chemical Exposition always has been an essentially chemical equipment show and will continue to be if the enterprise is to persist, for it is the backbone of its support.

While we would not call the exposition interests of these respective groups conflicting, they are of such diverse character that to reconcile them in a satisfactorily managed and business-resultful Show, will require more showmanship today than in war-time when conditions peculiarly were conducive to commercial egotism.

THE independent movement which came into existence to correct conditions created by the International Exposition Co., should not be characterized as dissentious or destructive, when it is essentially constructive. Its talk has not been "loose" nor its criticism "vague." It has made the Chemical Exposition a subject of trade discussion whereby its character may be clearly understood, the weaknesses of the Exposition management disclosed, and suggestions to make the enterprise live up to its potentialities become the duty of every man who knows the place and possibilities of chemistry.

Recent disclosures indicate that the present Advisory Committee, by its failure to function in accordance with the theory of its constitution, has sacrificed the confidence of exhibitors. Activity of a few at this late date only confirms an opinion long and generally entertained. Consistently it now should "check out," and a business advisory committee of exhibitors be appointed to consider and enforce the following "suggestions:"

1. Free drinking water.
2. Classification of exhibits.
3. Adequate ventilation on upper floors.
4. Adequate, accessible and sanitary lavatories.
5. Less arrogance on the part of individuals of the management.
6. No perquisite, privilege or favoritism of any kind to any exhibitor.
7. Restaurant service in the building at a price that comports with chemical salaries.
8. No free space to any organization designed for profit irrespective of its purpose.
9. Less extortionate charges for service and supplies and no share by the management in such charges.
10. No chemical advertising medium identified in any way with the management of the Exposition, either *sub rosa* or openly.
11. Representation of exhibitors, by men selected by the several classes of exhibitors, in the management of the Exposition enterprise.
12. No misrepresentation as to attendance. Reliable statements of class and volume of entrants to the Show to be supplied to exhibitors.
13. No misrepresentation as to the number of exhibitors. Bi-weekly statements of the names of exhibitors who have contracted for space.

14. No individuals promoted as "advisors" because of assumed ability to impart prestige to the Show. With an advisory committee of exhibitors participating in the management of the Exposition, this class of individuals can be segregated as a "Board of Patrons" and the Exposition enterprise thus dignified with the approval of their respective societies or trade organizations.

15. The Advisory Committee should embrace only representatives from classified groups of exhibitors, whose presence would indicate that a business-like scrutiny of production costs and methods of management would be assured. "Window-dressing" on the Advisory Committee doubtless is considered essential by the management to give the Show prestige in the solicitation of patronage; but with the exposé of the carelessness of this Committee, with this element dominant, in the elementary business matter of conserving the consideration for their services, this array of talent in the future will be less impressive and certainly without effect upon the cognoscenti.

If there is any warrant for the suggestions for improvement which have been enumerated, there is ample justification for the independent movement to make the Chemical Exposition the enterprise of the industry itself. Accordingly, dissatisfaction will not be eliminated until everything in connection with the Chemical Exposition under the management of the International Exposition Co. is open and above-board and subject to the scrutiny of representatives of classified exhibitors, in whose business acumen the financial supporters of the Show have confidence.

To the Advisory Committee constituted as outlined we respectfully suggest that it assume at once the responsibility of coordinating and controlling—the Cottrell man would say precipitating and collecting—all effort to breathe life into this institution, that there may be an end of rival bodies animated as much by self-advertising as by a desire to preserve it; that they make the Exposition show (1) what are our chemical industries and (2) how chemistry makes things for our national welfare. To sell chemistry to the public and to satisfy exhibitors whose money makes the show possible, are the two horns of the steer this new Advisory Committee will have to throw at our Chemical Rodeo.

IF there is one thing that the agitation over the Chemical Show has brought to the surface it is the poverty of American chemical enterprise in leadership. Where is there in the fundamental industry a man who can speak with the authority of Judge Gary, or who can command the confidence of Chas. Schwab, or who is big enough to interest himself in subjects of general interest to the industry, without seeking to pull off something of personal benefit? Capable industrialists are to be found in every branch of applied chemistry, but the industry's organized activities drift into the hands of men analogous to those who in American politics make the work of government distasteful to men who should participate.

The chemical industry needs salesmen of a calibre comparable to men of other industries who always are listened to with respect on occasions when Chambers of Commerce, Economic Societies, Boards of Trade, Civic Organizations, etc., assemble to discuss fundamental policies of government and industry. Two principles underlie this situation, to wit: to make friends in a national way we must be friendly through the instrumentality of men who typify the business force and progress of applied chemistry. The men most effective for this work are men who as business administrators know how to make money out of chemistry, for they speak in terms the public understands. The other principle is that the "talkers" we have for industrial chemistry are not of repute as "doers" and their audience and influence correspond accordingly. The situation is not unlike that in respect to technical books: Those who do write them often are without practical experience; those who have practical experience either from inability to express themselves or for personal motives will not write them.

The American people has come to know the chemical industry through the wire-pulling of politicians, the fulsome glorification of business agents, the garrulity of story-tellers and the publicity-seeking of small-bore men for the benefit of some institution in the background. Applied chemistry has no big man with which the public can personify its place in American industry.

FEW chemists, if any, have had the genius of Louis Pasteur to translate into industrial efficiency and human welfare their grasp of the intricacies of chemistry. To commemorate the 100th anniversary of the birth of this Alsatian tanner's son, the French Government has contributed two million francs by a measure in which the man is memorialized as "The Symbol of French Science." In contrast with this grateful acknowledgment of the value of Pasteur's life, we find in America no interest in tribute to a man who, above all others, personifies the creative character of chemistry, and to whom, we, with all the world, are indebted beyond calculation.

Commendation is due to Professor van Klooster for his appreciation of society's indebtedness to one who has done much for his fellow men and for his timely summary of the life and work of this wonderful man. He contrasts the honors paid to the destructive and constructive elements in human progress by citations from the philosophies of Pasteur and Bismarck to show that "Peace hath its victories no less renowned than War." Human nature always has acclaimed the soldier over the scientist for reasons deeply rooted in the biology of the race. Without waiting for that remote time when shrines shall be built for scientists let us take heed that the great achievements of the world have been done in the day's work, without expectation of greater reward than the satisfaction of duty done, which in its highest glorification is for the race.

COUNSEL to chemists in matters that affect their material welfare should reflect on the part of the counsellor not only practical experience but such intimacy with the class and the conditions of its work, that the advice will carry conviction and command respect. The American Chemical Society through its chief publication asks "How many of our chemists, particularly the younger men, have been trained as chemists and nothing more?" and states that "We should be able to cultivate a minor occupation without detracting from our usefulness as chemists." Our discussion of this subject is of direct application to the work of chemical educators and to the responsibilities of employers of chemists and will not be without pertinent value to the work of Society editorship.

A man whose capacity entitles him to be called a chemist has been trained as a chemist and nothing more. Unsatisfactory employment conditions in the practice of chemistry arise from the surplus of men who have not been trained enough in chemistry and that great numbers of which lay upon their employers the burden of further training, necessarily specialized, for which they must pay in the figures of a wage inferior to that of numerous organized vocations. Success as a chemist means such breadth and depth of academic training in chemistry and related sciences as leaves to the young man neither time nor taste for preparation for subsidiary vocational activities.

This is the age of the specialist. For the foremost educational society in chemistry to encourage immaturity which has specialized in chemistry to think that its special training qualifies it to undertake another specialist's work, is egregious when common observation is that when it is done it is more in spite of chemical training than because of it.

The specialization and concentration requisite for employment as a chemist and the necessarily exclusive character of his industrial work are the root of the economic helplessness of the professional workers in chemistry. For the American Chemical Society to advise young men who have chosen chemistry as a career to develop an income-producing side line to their professional work not only discloses the flimsy basis of our present system of chemical segregation but the gross ineptitude of the editorial counsel of our Society which flows therefrom, in matters entirely foreign to its scientific and educational purposes.

Such advice is an example of the straddle consistent with the doctrine of a single organization, under the control of a handful of chemical politicians, to serve the diverse needs of a great group of highly specialized educated workers in industry.

IF our present system of chemical segregation is sound, i. e., that it provide the service demanded by conditions, then employers have a responsibility not yet emphasized to cooperate with chemically trained help to develop for them a source of income outside the plant. Such distraction of interest naturally is at a sacrifice of results expected of specialists, but we must remember that industry today is governed by humanitarian, to the exclusion of economic considerations. If such cooperation, however, is not forthcoming, the chemically trained man is left alone to qualify himself for some "minor vocation in times of industrial stress."

The resourceful will suggest that paint chemists take up house-painting; that chemists handy with tools can qualify as plumbers' helpers; that concrete work invites cement chemists; that the soap chemist can drive a laundry wagon; that work as a dry goods clerk is open to the dye chemist of pleasing address; that the food chemist is fit for counter-man in a restaurant and the milk chemist for a job in a dairy; that explosives chemists in the summer can clerk and double as maid in the nearby summer hotel and in winter can trap muskrat and skunk; those chemists living in the suburbs can raise chickens and mushrooms or develop a mail-order business in a furniture polish or rheumatism cure or a great discovery to increase the mileage of gasoline; many can work as bookkeeper, typist or comptometer operator; others can sell bonds, books, life insurance or stock in adolescent chemical corporations; certain qualities developed in scientific investigation would be valuable in the work of the installment-house collector; women chemists can take home bead-work; and in addition to the acquirement of ability to write well, speak engagingly and look good, let it be remembered that no chemist's armor against adversity is complete until he is qualified to run and repair an automobile.

SUCH comment will fail of its purpose if every member of our Society is not made to believe that it should be imperative that every editorial in the Society publications should be signed by the author. This excellent rule is observed in the conduct of the publications of the American Society of Mechanical Engineers and of the American Society of Mining Engineers and Metallurgists and in the admirable publication of the Chicago section of the American Chemical Society, *The Chemical Bulletin.*

Nothing would be more effective than such publicity not only to compel the display of capacity in the discussion of the problems of chemists and chemistry, but to disclose the sources of inspiration of those who would influence opinion. The salary of $10,000 a year which the managers of the Society in secret session decreed for this job is so out of line with the editorial requirements of the work and the results produced that the members of the Society are entitled to know who writes its editorials.

The editor essentially is a teacher. The Bureau of Education states that the average salary of deans of colleges for 1921-1922 is $4250, a 38.8-per cent increase over the average of 1915-16; that of full professors for 1921-1922 is $3,392, a 41.3-per cent increase over the average of 1915-16. The further poor alignment of this figure with industrial salaries can not fail to arouse curiosity as to what qualities our Society managers sought that they considered worth the additional $6,000; the opinion of some is that their personal incomes determined the size of this figure. The time is past for obsequious acquiescence in the democracy of American chemistry.

I. Appliances for Moving Liquids in Chemical Plants

By A. K. Fischer

President, Schutte & Koerting Co.

IN many chemical plants manufacturing operations involve the handling of raw materials in liquid form, which when received must be pumped from tank cars into storage tanks. The chemical reactions subsequently carried out demand often that solutions must be transported several times from one part of the plant to another, or elevated to tops of towers through which the solutions percolate during the reaction. Finished products, such as acids, alcohols, coal tar products, fats and oils, etc., when ready to be shipped must be pumped from storage tanks into tank cars.

For this purpose pumping appliances are required that withstand the corrosive action of the material handled and at the same time are reliable in operation.

The principal means of moving liquids may be classified as follows:

Table I—Chemical Pumps

Mechanical Appliances	Motive Power
A. Jet Apparatus	
1. Syphon or Steam-Jet Pump	Steam-jet
2. Air-jet Lift	Compressed air
B. Vacuum Lift	Steam-jet Air-jet
C. Pneumatic Displacement Pump (Blow case, acid egg, montejus)	Compressed air
D. Diaphragm Pump	Pulley drive
E. Rotary Pump	
1. Gear Pump	Pulley or motor drive
2. Centrifugal Pump	" " " "

These appliances are made of iron, bronze, lead, hard rubber, porcelain, stoneware, monel, ilium and other materials that resist the corrosive action of the liquids handled. The iron mentioned is an acid-proof cast iron that is free from sulphur. Enamel is sometimes used as a coating.

Experience has determined the selection of materials in pump manufacture. Bronze is the preferable ingredient for pumping acetic acid, acid mine-water, crude alcohol, petroleum products, bitter mineral water, sodium chloride brines, cane juice, copper cyanide, cyanogen, glycerin, iron and lime sulphates, linseed and rape oils, molasses, hydrogen sulphide, conc. sulphuric acid, tannic acid, and numerous other products. Iron is suitable for alkaline waters, calcium chloride solutions, alkalis, coal tar products, neutral salts, soap, raw materials, and a great variety of inert materials. Lead is used for alum liquors, bisulphite liquors, phosphoric acid and sulphuric acid of all temperatures and concentrations. Stoneware is demanded by such materials as chlorine, hydrochloric, nitric and tartaric acids, and such as attack metals to the degree that exposes the product to contamination or subjects the appliance to rapid deterioration. Hard rubber is suitable for hydrochloric acid; its high resistivity commends it widely in chemical process work.

The Syphon

Of the various devices for pumping liquids, the steam-jet pump, commonly known as the syphon, is the simplest. It is rugged in construction, easy to handle, low in first cost, reliable in operation, and in instances where a liquid must be both heated and elevated, the raising of the liquid may be considered an almost costless function.

The operation of the syphon is obvious from Fig. 1. Steam is admitted at the left hand side in each example shown, and discharged through the steam nozzle into the combining tube, evacuating the liquid supply or suction pipe, and causing the liquid therein to rise until it comes in contact with the steam. The steam emerges from the nozzle at high velocity, condenses on meeting the liquid, and imparts sufficient momentum to the liquid to discharge it through the outlet at the right against the required elevation. As the liquid flows from the entrance of the combining tube to the throat, its velocity gradually increases until at the throat of the tube, the velocity is at a maximum. At this point all of the steam has been condensed. From the throat to the exit, the tube diverges, and the velocity is transformed into pressure which is sufficient to force the liquid to the required elevation.

Table II—Syphon Steam Pressures for Different Elevations

Total Elevation, ft.	Steam Pressure, lbs. per sq. in.
40	40
60	60
80	80
100	100

Table II shows the steam pressures that are required for elevating liquids to different heights. In order to obtain the best results, the syphon should be suspended just above the surface of the liquid to be lifted, but the syphon may be either immersed in the liquid or suspended above the surface at a greater height within the limits of suction given in Table III.

Table III—Limits of Syphon Suction

Steam Pressure, lbs. per sq. in.	Limit of Suction in ft. Steam valve open full	Limit of Suction in ft. Steam valve cracked and opening closely regulated
20	18	18
40	18	20
60	15	24
80	12	24
100	9	24

If the total elevation to which the liquid must be pumped is not too high, syphons can be used even for 24 ft. suction when the steam is turned on full. For use in cases where the syphon can be immersed or where the liquid flows to the syphon by gravity, special

---

This is the first of two articles descriptive of mechanical appliances for handling liquids in chemical plants. Following the present discussion of the application of the syphon and air-jet lift will be the description of the pneumatic displacement, diaphragm and rotary pumps and their use in chemical manufacture.—Editor.

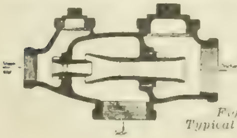


Fig. 1
Typical Syphon

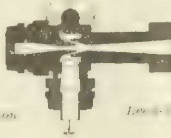


Fig. 2
Lead-lined Iron Syphon

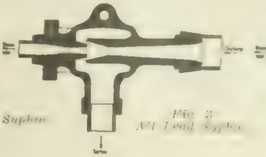


Fig. 3
All Lead Syphon

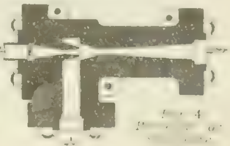


Fig. 4
[illegible]
Syphon

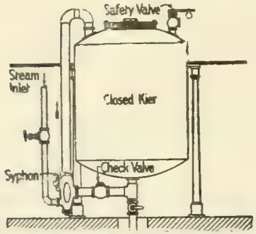


Fig. 5. Syphon for circulating liquors in a closed Kier

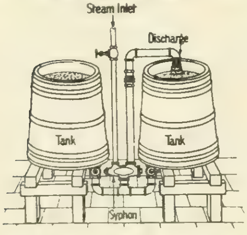


Fig. 6. Tannic acid circulated by means of a syphon

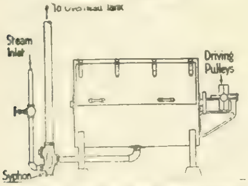


Fig. 7. Syphon used in chrome drum for tanning leathers

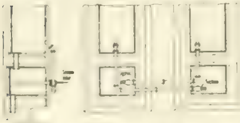
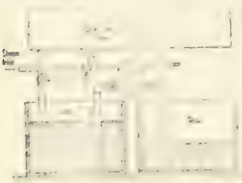
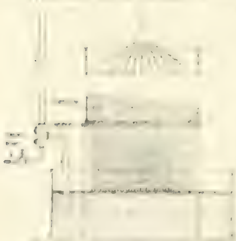


Fig. 8. Acid pickling bath circulated by syphon



[illegible]



[illegible]

syphons are obtainable that will overcome total elevations twice those given in Table III, and that will handle solutions at 120° F.

Table IV—Syphon Steam Consumption

Elevation Feet	Increase in Temp. Fahr	Ratio: Steam Consumed to Liquid Discharged
20	15	1:84
40	20	1:65
60	24	1:58
80	28	1:48
100	32	1:42

The approximate ratio of steam consumed to liquid discharged and the corresponding increase in the temperature of the liquid during the pumping operation are given in Table IV. The steam pressures required for elevating acids of different densities are given in Table V.

Table V—Heights to Which Liquid Can Be Raised With Different Syphon Steam Pressures

Steam Press. Lbs. per Sq. In.	Density of Acid Deg. Bé. 10	20	30	40	50	60
	Height to Which Acid Can Be Raised					
20	24	22	20	18	16	14
40	48	44	40	36	32	28
60	72	66	60	54	48	42
80	96	88	80	72	64	56

Syphons are frequently made of brass or iron, or with iron bodies and brass nozzles. For lifting substances that have a destructive action upon iron or brass, syphons are made of lead, porcelain, stoneware or hard rubber. The accompanying table itemizes a few materials and the more common liquids for which they are employed.

Table VI—Materials of Which Syphons Are Made for Various Chemicals

[illegible]

In order to operate efficiently and to be reliable in service, syphons must be carefully designed and

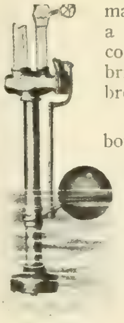


Fig. 11
ball float
Syphon regulated
automatically by

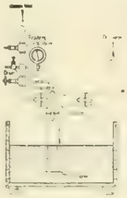


Fig. 12
Method of installing syphon

made of the proper materials. Ordinarily a material that resists effectively the corroding effect of the liquid is soft or brittle and liable to injury by abrasion or breakage.

The selection of the proper material, both to afford the necessary reliability of construction and at the same time to insure efficient operation, is of importance. High-grade equipment should not be considered on the basis of first cost alone. Because of the longer and more satisfactory service that such equipment insures it is always less expensive than cheaper equipment of inferior grade.

A typical lead-lined, acid-resisting syphon is shown in Fig. 2, and consists essentially of a lead body, having a lead steam-nozzle protected by a platinum alloy lining. The body of the syphon is armored by a shell of iron so that the exact alignment of the syphon parts cannot be disturbed or the strength of the apparatus impaired. The iron shell is made with flanged connections for the external lead piping, the lead pipe being expanded and clinched between the flanges, as shown in the figure, thus providing a connection that is easily made and as easily disconnected.

An all-lead syphon is shown in Fig. 3. It has heavy body walls that afford adequate protection against breakage. The steam-nozzle is made of a plantinum alloy. The all-lead syphon is used wherever the syphon must be entirely submerged in the liquid and subjected both on the inside and on the outside to corrosive chemical action. It is ordinarily attached to the pipe line either by hose nipples, or, preferably, by burning the pipe to the syphon.

Syphons made of porcelain or stoneware resist effectively the action of practically all chemicals, hence are well adapted for lifting all kinds of liquids; but porcelain and stoneware are brittle materials that are readily broken by careless handling or by sudden changes in temperature. For this reason porcelain and stoneware syphons of modern construction are completely armored; a typical construction is shown in Fig. 4. Syphons are also made of hard rubber, aluminum and special alloys to meet special requirements.

A typical syphon arrangement for circulating lye in a closed kier, used in bleaching or washing, is shown in Fig. 5. Here it is highly essential to cause the lye to circulate at a uniform speed and at the same time to keep the required temperature throughout the process as constant as possible. Figs. 6, 7, 8, 9 and 10 show typical applications of syphons for (a) extracting tan bark, (b) employing a chrome drum in the dyeing process, (c) circulating acid in a pickling vat wherein iron or steel is treated with dilute acid in order to remove the iron oxide scale, (d) lifting a solution alternately from one tank and then from another and discharging the solution into an overhead tank, from which it is subsequently removed as required, and (e) circulating acid to top of a reaction tower.

The syphon is admirably adapted to all these applications, inasmuch as it resists effectively the corrosive action of the liquid handled. It has no moving parts.

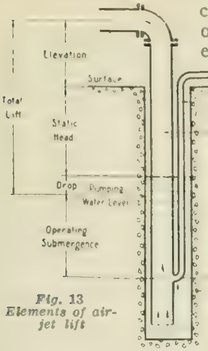


Fig. 13
Elements of air-jet lift

consequently there is little wear or tear. It does not require engines, belting or gearing for driving or oiling or attendance of any sort. No foundations are necessary, as the piping provides ample support for the syphon. Furthermore the syphon can be operated automatically, but in most instances automatic operation is limited to liquids that do not attack copper and that therefore permit the use of the ordinary copper ball float. Lead and stoneware are not suitable for this purpose.

A typical automatic syphon is illustrated in Fig. 11. As the liquid fills the pit to the upper level, it raises the copper ball float, thereby snapping open a steam inlet valve and putting the syphon into service. When subsequently the liquid is removed and the float sinks to the lower level, the snap valve is closed, steam is shut off, and the syphon made inactive until the pit is again filled. It does not stick in an intermediate position, and under these conditions no steam is wasted. In order to obtain the best results, syphons should be installed as shown in Fig. 12. The regulating stop valve is throttled and the steam pressure is reduced to a pressure at which the syphon operates most satisfactorily. The valve is then locked in this position. The operating stop valve is used for turning on and shutting off the steam. Before the syphon is started up, the drain is opened in order to discharge the accumulated condensation. There should be no traps in the delivery pipe, and the suction pipe should be air-tight.

Air-Jet Lift

The air-jet lift is a simple device for lifting liquids by means of compressed air. It consists briefly (see Fig. 13) of a compressed air pipe, a discharge pipe and the air-jet lift proper, three types of which are shown in Fig. 14. Fig. 15 shows a typical installation where both the compressed air pipe and the discharge pipe are immersed in the liquid in a well. Compressed air is forced through the air pipe and air-jet lift into the discharge pipe, where it is thoroughly mixed with the liquid to form a complete emulsion of air and liquid. This mixture has a lower density or less mass per unit volume than the liquid in the well outside the discharge pipe. Thus an unbalanced hydrostatic pressure is created that is sufficient to force the mixture of air and liquid through the discharge pipe. This discharge is further assisted by the kinetic energy or energy due to the upward motion of the compressed air, which, as it rises in the discharge pipe, expands and imparts velocity to the liquid. The air-jet lift is in fact an air expansion pump.

To operate the air lift, it is merely necessary to open a valve in the compressed air line. The quantity of liquid discharged is regulated by increasing or decreasing the air supplied. An installation in which the liquid to be elevated is carried to the pump by means of a separate pipe is shown in Fig. 16. The value of the air-jet lift lies in its simplicity, durability, reliability, low maintenance cost and flexibility. It can be made of cast iron, cast steel, bronze, monel, hard lead, hard rubber or porcelain. Air-jet lifts of lead and hard rubber are used for pumping acids and corrosive liquids and for agitating chemicals in textile mills, dye works, bleacheries, etc.

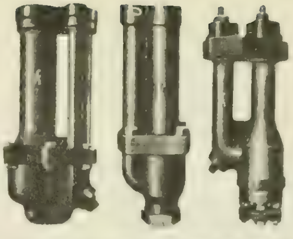


Fig. 14—Cast iron, brass and lead air-jet lifts to appropriate uses

The air-jet lift works as long as air and liquid are carried to the device. It occupies small space, but in order to operate successfully it requires the proper submergence, which is often a disadvantage that precludes its use in certain instances. To enable the reader to become familiar with the usual procedure in solving air-jet lift problems, a concrete case will be considered.

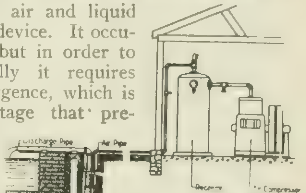


Fig. 15
Air-jet lift immersed in liquid to be raised

Suppose that a solution of specific gravity unity is to be elevated 20 feet to the top of a tower, as in Fig. 17, at the rate of 15 gallons per minute. At what depth below the center of the liquid supply pipe must the pump proper be installed in order to obtain the necessary submergence to raise the liquid to the required height; furthermore at what pressure must the compressed air be supplied, and what is the power consumption in compressing this air to the desired pressure?

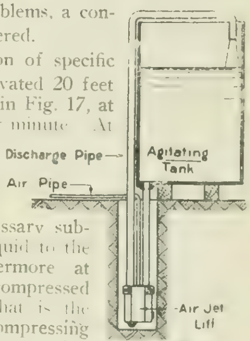


Fig. 16
Air-jet lift of hard [illegible]

The total lift or height above the liquid supply pipe to which the liquid must be raised is 20 feet. This is defined as the total lift. Hence, from Table VII, the percentage submergence is 70.

Table VII Percentage Submergence

Lift, Feet	Submergence Per Cent	Lift, Feet	Submergence Per Cent
20 to 50	70	251 to 350	55
51 to 100	67	351 to 500	50
101 to 150....	65	501 to 700	45
151 to 250	60	701 to 1,000	40

Percentage submergence is defined as the ratio of the operating submergence to the operating submergence plus the total lift. Expressed algebraically, this definition becomes: Percentage submergence $= S_2 \div (S_2 + L)$, in which S_2 is the operating submergence, i.e., the distance below the center of the liquid supply pipe at which the pump proper must be installed, and L the total lift. Obviously, in an installation of which Fig. 17 is typical, it must be practical to locate the air-jet lift at

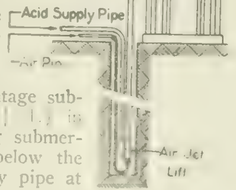


Fig. 17
Air-jet for raising Acid to top of Glover tower

the necessary depth below the supply pipe in order to raise the liquid to the desired height. In instances of this kind, both the liquid to be pumped and the compressed air are passed to the pump proper by means of separate pipes.

Reverting to the preceding equation, and substituting therein the values of the total lift and percentage submergence, we have: $.70 = S_2 \div (S_2 + 20)$, in which $S_2 = 47$. That is, the pump must be installed 47 feet below the supply pipe.

Neglecting losses, the working air pressure in pounds per square inch is found by means of the following equation: $P_2 = [S_2 - (V_2 \div 2g)] \times .45$, in which P_2 = the working air pressure in pounds per square inch; S_2 = the operating submergence in feet; V = the upward velocity of the liquid in the discharge pipe in feet per second g = 32.16 feet per second, and .45 = the weight in pounds of a column of the liquid 1 foot high and 1 square inch in cross section.

If the initial velocity of the liquid rising in the eduction pipe is 8 feet per second, a value that is based on the actual performance of a large number of similar installations, the pressure in pounds per square inch is $P_2 = [S_2 - (V_2 \div 2g)] \times .45 = 47 - (64 \div 64 \times .45$ = about 21 pounds per square inch.

Submergence Feet	Specific Gravity Of Liquid											
	.8	.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	6.24	[illegible]	7.28	7.80	[illegible]	8.84	9.36	9.88
[illegible]	[illegible]	[illegible]	10.40	11.44	[illegible]	[illegible]	[illegible]	[illegible]	16.64	17.68	18.72	19.76
[illegible]	12.48	[illegible]	[illegible]	[illegible]	18.72	20.28	21.84	23.40	24.96	[illegible]	[illegible]	29.64
[illegible]	16.64	[illegible]	[illegible]	22.88	24.96	[illegible]	[illegible]	31.20	33.28	[illegible]	37.44	39.52
[illegible]	[illegible]	23.40	[illegible]	28.60	31.20	33.80	36.40	39.00	41.60	44.20	46.80	49.40
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	40.56	43.68	46.80	49.92	[illegible]	56.16	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
80	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	62.40	[illegible]	[illegible]	[illegible]	79.04
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	70.20	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	78.00	83.20	88.40	[illegible]	98.80
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	80.08	[illegible]	[illegible]	97.24	[illegible]	108.68
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	101.40	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	140.40	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Table VIII—Air Pressure Pounds Per Square Inch

According to Table VIII, for a submergence of 47 feet and a specific gravity of 1.0, the required air pressure is 24 pounds per square inch, taking into account the losses. The quantity of air required is approximately determined as follows: A = WL ÷ 20), in which A = the quantity of free atmospheric air under standard conditions of pressure and temperature in cubic feet per minute; W = the quantity of liquid in cubic feet per minute, and L = the total lift above the mean elevation of the liquid supply in feet. In the problem considered $A = (15 \div 7.48) \times (20 \div 20) = 2$ cu. ft. of free atmospheric air per minute. The factor 7.48 is used in order to convert the liquid from gallons per minute into cubic feet per minute.

In connection with a Glover tower, see Fig. 17, the discharge pipe is extended to the top of the tower and thereupon arranged to discharge against a plate that distributes the solution uniformly over the towers. Fig. 16 is an application of a hard-rubber air-jet lift for agitating a chemical liquid. For this purpose, the air lift is superior to mechanical means of stirring, inasmuch as it does not introduce into the liquid any foreign injurious substance, such as dirt, oil or grease. Fig. 18 embraces diagrams of typical installations for lifting a chemical solution from a tank on a lower floor to another tank on a higher floor and shows how the air lift is used for transferring a solution from one vessel to another. Also is shown the air-jet lift wtih an automatic regulator, whereby the air lift is started up when the float reaches its highest position, and is shut down when the float falls to its lowest position.

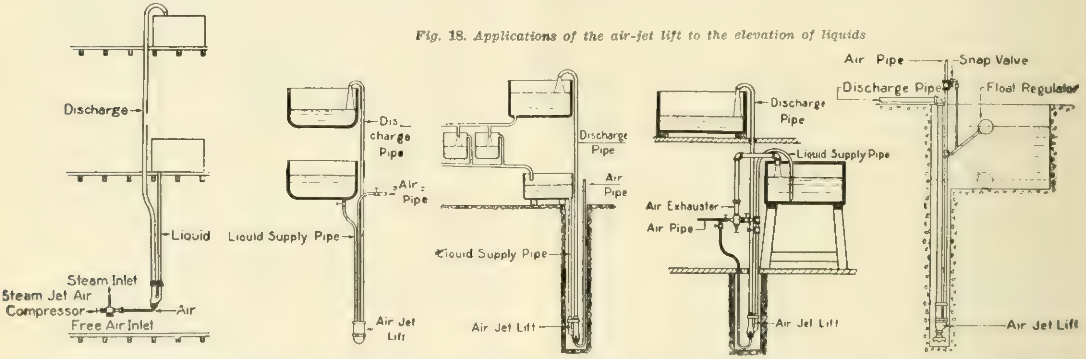


Fig. 18. Applications of the air-jet lift to the elevation of liquids

---

Standardization of Chemical Analysis by Agricultural and Food Chemists

The Association of Official Agricultural Chemists will hold its 3-day annual meeting at Hotel Raleigh, Washington, D. C., Nov. 15-17. Particular consideration will be given at this meeting to agricultural chemistry with regard to the control laws affecting food and drugs, stock feed, commercial fertilizers and insecticides and fungicides. One of the chief objects which the association will attempt to accomplish will be the standardization of methods used by the various chemical analysts engaged in the work at different stations, so that the findings of one station may be comparable to those of another station. The methods devised and recommended by the association have become quite generally used, but it is hoped that there will be a still further co-ordination of effort effected.

Cellulin Corp., 835 Caswell Block, Milwaukee, Wisc., will erect a plant at Milwaukee for the manufacture of cellulin, a transparent paper which will be marketed in rolls in various thicknesses, as light as .001 inch. This paper which is soft and silk-like lends itself to the highest grade of printing and lithography and is unaffected by acid, alkali or oxidizing agents of ordinary concentration. It does not burn as readily as paper and the heavier grades are claimed to be adaptable for motion picture films.

III. Random Recollections of an Old Professor

Some High Spots in the Perspective of Fifty Years' Activity as a Teacher of Chemistry, as a Chemist and Engineer, as a Chemical Manufacturer, as an Author, Editor and Publisher, and as a Politician

By Edward Hart, Ph.D.
Professor of Chemical Engineering, Lafayette College

THE field of Chemical Engineering is so large and its boundaries so ill-defined, perhaps impossible of definition, that "the writer whose own experience shall fully qualify him to cover this whole subject is still to be discovered."

Textbooks on Chemistry

This quotation from the preface to the first edition of my "Text Book of Chemical Engineering" states a fact which will be increasingly true as the years roll around. It also is true that most of the theory of the various operations is incomplete, sometimes erroneous. I have been criticized, perhaps justly, for having included so little theory in this book. It does not seem to me necessary, however, to include all that is known in a book for beginners on any subject. It is assumed that the teacher knows more than the text book, though this is often incorrect, and that he may wish to add to the statements there made from papers published since its issue.

Most text books are judged by the teacher from the wrong angle. They are considered poor if they do not contain something of which the teacher was ignorant. In other words, if it does not help the teacher it is unfit for the pupil. This is not true. Text books should be more carefully made. They should seek to solve the problem: How little dare I give? and not: How shall I show my great erudition? It is constantly forgotten that every competent manufacturer must go over the same operation many times before he can hope to master it, and that beginners in the general subject must work on the same lines. It is little less than a crime for the teacher to stun and discourage the beginner by any but the simplest and most direct statements, leaving to a later period the qualifications which are necessary.

Observations in Chemical Manufacture

My own experience in manufacturing is of course confined to a somewhat narrow field in spite of the fact that it covers the period since 1881. In that period I have learned very fully the lesson not to enter on any new line of work without a very careful study of the experience of others and if possible a small scale study of the operation in all its details. I have read many of the wonderful stories of what American chemists did during the war with a feeling of dislike. Chemists are no less fallible than other men, and some of the graduates in chemical engineering from famous schools made a disastrous display of cocksureness. There are not a few men teaching the subject, devoid of much experience, who speak with no uncertain note.

In 1881 we had hardly any theory; the practice was often primitive to the last degree; not infrequently trade practices were not defensible. I know, for instance, of a case where sulfate of soda was shipped on an order for Epsom salt and the cheat was not discovered. There were very few sources of information, and most of what was known was most carefully and jealously concealed. At that time we began making pure hydrochloric acid by heating a mixture of salt and about 60° oil of vitriol in a glass flask on an iron plate and leading the gas into distilled water. I had had excellent training in analytical chemistry and soon discovered that the product always contained sulfuric and sulfurous acids, and that it was necessary to redistill the product in order to get pure acid. We had one adverse experience after another in this work. It may be interesting to cite two of these:

We discovered that our acid contained chlorine. This was finally traced to the salt which had been made by boiling down nitrate of soda and potassium chlorid. This disappeared when we substituted genuine sea salt from Syracuse, but a little later it appeared again. This was in the spring, and after a long and vexatious search we discovered nitrates in the spring water which had been used to dilute the oil of vitriol to 60°. In the course of this work I was obliged to design a new condenser to fit our practical needs. In doing this I gave study to the theory of the condenser. I discovered that the Liebig condenser was very inefficient but that by narrowing the space between the inner and outer tubes, and so increasing the rapidity of flow of the cooling water, it became very efficient. I am now using in my laboratory condensers on these lines made entirely of glass.

In studying the distillation of nitric acid I made a number of distillations in glass retorts the results of which were published in a paper printed in the *Journal of the American Chemical Society,* Vol. 17, p. 580. I here called attention to the frothing which occurs and gave the explanation. Most of the researches I made have never been published for the reason that my partners thought this inadvisable and I did not feel free to disregard their wishes. I presume to a certain degree this disadvantage is necessary in the case of those concerned in solving commercial problems. I think after this lapse of time I may describe a few of these operations without impropriety.

One of our early efforts was to make pulverized zinc. This was originally done by pouring the zinc heated to the melting point into a wooden box and shaking the box. The wood was charred and a certain amount of charred wood contaminated the product. I think it was Adamson who suggested that we use an enameled iron vessel instead. Then we improved still further by mounting the enameled iron bucket on the end of the driving rod of a small upright steam engine. We found it unnecessary to cover the bucket; simply turn in the zinc and let her go.

We sold imported carbonate of soda until one of our customers brought in a platinum crucible which had a thousand minute holes caused by as many fragments of lead; this lead could be separated from the soda by dissolving it in water. We concluded that this carbonate had been dried in leaden vessels and the particles must have been produced by scraping this loose with a spatula. Thereafter we made our own carbonate in vessels made of pure, thin sheet silver by bending up the corners of the sheet metal.

We made pure white cuprous chlorid by precipitating it with sulfurous acid from copper sulfate and salt, washing with boiled water and drying in a vessel made of cast copper. It is difficult to produce such castings unless some phosphorus is added to the melted copper.

We adopted the policy of selling our condenser to other manufacturers and undertook putting it up and instructing our clients in its management. In this way we often came into possession of information about how this and other processes had previously been performed. I remember "Matt," a burly Irishman who had put up a condenser for Powers & Weightman, told me that they put the nitrate of soda into a cast iron pot. A plank was laid and the oil of vitriol was carried up the plank in pitchers and poured in. In England I found that most of the manufacturers were using iron pots about six feet long laid horizontally in the furnace. They were charged with enough oil of vitriol to form the neutral sulfate and were distilled very slowly—sometimes for 48 hours, using as much coal as nitrate. One maker refused to make the slightest change. He said his acid satisfied the etchers perfectly and he was averse to any risk. Henry Glover, a son of John Glover, the inventor of the Glover tower, was superintendent for Powers & Weightman at the Falls of Schuylkill, and I made his acquaintance. He told me that they were making a strong and pure sulfuric acid from sulfur in a specially modified Glover's tower. This had a platinum dish in the lower part into which the acid ran and overflowed. Below it the sulfur burned, giving sufficient heat to concentrate the diluted acid. I tried to be square with the manufacturers. Upon one occasion the chemists were invited to visit the Grasselli works at Cleveland. I sent word to Cesar Grasselli that he ought to know that I was a manufacturer and perhaps he would like to withdraw the invitation. In return I received a special invitation to come and had a special guide who was instructed to answer my questions truthfully.

General Chemical Company

Before the formation of the General Chemical Company chemical manufacture in and around New York was the scene of fierce competition. Prices were cut to the bone; no one was making any money, and the plants were getting into disrepair. I have reason to think it was Dr. Nichols' reputation for fair dealing which made possible his consolidation of rival interests. This was a mighty good move for all concerned. There was only a small stiffening of prices, but the works were soon overhauled and both processes and product were steadily improved.

J. B. F. Herreshoff had a large share in this. Every one liked J. B. He was as strong as a horse and could eat more beefsteak than any other man I ever knew. His improvements were ingenious, carefully developed and skillfully applied. Upon one occasion he led a party of chemists over the Nichols Copper Works and gave us a lecture which was remarkable for the small amount of information it contained. I was very fond of James L. Morgan, whose acquaintance I had made before the consolidation.

Dr. E. R. Squibb

Other interesting men of the operating force were [illegible] Wannemaker [illegible] Parker, who had learned the business under Dr. Squibb, whose memory they revered. It was natural, for Dr. Squibb was a remarkable man in many ways. He began, I think, by distilling wood in a factory in Brooklyn. He drove off the water by slowly heating at a low temperature until the moisture was all over; then by further heating acetic acid and alcohol were produced without the formation of much tar. In consequence they were readily separated and purified. The residual red charcoal was sold at a good price to the grocers and the railroad companies for kindling fires. He also made ether in an apparatus of his own invention which was not patented.

By scrupulously fair dealing Dr. Squibb had built up a reputation which was a great business asset in the trade. He would tell any visitor all about his processes, and I believe he never took out a patent on any of them. He had been badly burned on the face, which was disfigured. No one noticed this, for he was the soul of good feeling and kindness, and, with the tears running down his cheeks, for he had no control over this secretion, he would tell us all about his operations and give figures of cost.

Dr. C. E. Munroe

At this time Dr. C. E. Munroe was chemist of the Torpedo station at Newport and our authority on explosives. He was well known and liked. When the American Chemical Society had reached ebb tide in numbers and influence he went the rounds, persuaded the chemists outside New York to join and soon put it on the road to prosperity. I remember with gratitude his personal kindness to me on several occasions.

Experience as a Publisher

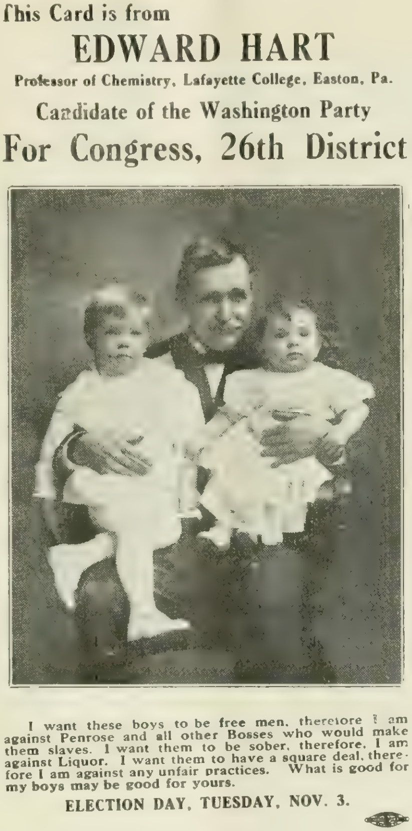
I began my career as a publisher by editing and publishing the first volume of *The Journal of Analytical Chemistry* in 1887. It was printed first by George West and later by Gus Eschenbach. From the beginning I had had trouble in getting the numbers out on schedule time, and realizing finally that if this was to be done I must also be my own printer, I began to make plans for this. In my teaching I had had need of the printer's art, and being too poor to pay for it I got a small press operated by foot power and filled up my evenings sticking type. The knowledge gained in this way was now of use. One of my students, Eugene C. Foster, had been a printer. Before he graduated I suggested that he become foreman of my proposed printing outfit on graduation, to which he assented.

In my yard were the remains of an old cow barn which once had housed the Faculty cow. This was torn down and a one-story structure built to house the new venture. Our outfit cost $700. We had a force of three people: The foreman, who was also compositor and printer; Miss Helen Smith, bookkeeper and proofreader, and Mansfield Smith, devil. The first issue from this office was the August number of *The Journal of Analytical and Applied Chemistry*. The execution of this issue was decidedly inferior, but we soon improved. In 1893 this was combined with *The Journal of the American Chemical Society*, of which I became editor, printer and publisher. In 1895, Remsen asked me to print his *Journal*, and other work came from all sides. Shortly my building had an added story, then an addition, and then the business was removed to the present building on North Third street, Easton, Pa.

Wiley's book on agricultural analysis was our first book published. It was issued in numbers, following the German custom; but we found this did not work well, and we finally issued it in two volumes. This was in 1894. In 1895 we published Langenbeck's "Chemistry of Pottery," and in 1896 Venable's "The Development of the Periodic Law." At this time Venable was Professor of Chemistry at the University of North Carolina, Chapel Hill, N. C. He afterward became president. But the fascination of chemistry proved too strong and he went back to his professorship as incumbent for life, decreed by an appreciative Board of Trustees. Before and after this I saw Venable often, and in 1917 I visited him. The story of this visit is told in *Chemical & Metallurgical Engineering,* Vol. 16, p. 13.

In the same year we published Mason's "Notes on Qualitative Analysis." It often has been said that there are too many books on qualitative analysis, but I wish there were more, for then more teachers would form the habit of writing and we should have more books some of which would be good books. Writing chemical books does not pay in money return but it does pay big dividends in other ways. In 1897 we published Snyder's "Chemistry of Dairying," "Stillman's Engineering Chemistry," and the third edition of my own "Chemistry for Beginners."

Stillman's book was called by one reviewer, "a heterogeneous collection of analytical methods," but it has been of great value to the profession and has had several editions. Stillman was a very interesting man and well posted on many subjects. He came to Easton many times and always left a budget of good stories and the memory of a pleasant visit behind him. He gave us good will, and since his death his son has shown that this good will continues in the second generation, for we are now printing for him and expect soon to publish another technical book.



This Card is from

EDWARD HART

Professor of Chemistry, Lafayette College, Easton, Pa.

Candidate of the Washington Party

For Congress, 26th District

I want these boys to be free men, therefore I am against Penrose and all other Bosses who would make them slaves. I want them to be sober, therefore, I am against Liquor. I want them to have a square deal, therefore I am against any unfair practices. What is good for my boys may be good for yours.

ELECTION DAY, TUESDAY, NOV. 3.

Publishers' Problems

If authors would listen to reason and type-stickers and linotype men were awake to their own interests the publisher's lot would be a happy one. Unfortunately both classes contain unruly individuals who fill the path of the publisher with thorns. The author usually knows much more about the business of publishing than does the publisher who has spent his life at it; it is beneath his dignity to take advice and he is foolishly suspicious. The linotype man has a boss in the labor union who makes him go on strike when it suits the boss. The printers are usually averse to strikes; they are the ones to suffer; most of them are good workmen and give a good return for their pay but they are overawed by their smart leaders and a few blatant, indecent, radical sillies. The boss printers have been exasperated in recent years to the point of desperation by all sorts of silly and malicious demands which they could not grant. This condition is not confined to this particular trade, but is common to many. Fortunately public disgust has become pronounced, and it seems likely that the tyranny of the labor union has reached high water mark and is on the decline.

The Chemist in Politics

I have been and am a very poor politician. Politics is indeed a misnomer for much that is classed under that name. Much of it deserves a harsher title. The real thing, however, always seemed to me worth while, and sometimes questions arose which impressed me as of such importance that it became a duty to get busy. From the beginning I was stoutly opposed to Don Cameron, Matt Quay and Boies Penrose. I have been told and believe that in many ways they were very worthy men, but their political conduct always seemed to me to be unworthy of statesmen. Once I organized a revolt in the Third Ward which was successful We sent three delegates to the convention at Bath. I was one of the delegates. We were very lonesome and before the proceedings were over I bolted, followed by the derisive laughter of nearly all the delegates. Next year, after the decent element had voted at the primaries, the heelers were let in and overwhelmed us.

In 1912 I was nominated for Congress in the 26th District and made an active canvass as the candidate of the Washington Party. I traveled over four counties and saw many voters, but appear to have made little impression, for I was a bad third in the poll. During this campaign I saw much of Gifford Pinchot and formed a high opinion of his ability and courage. I do not wonder that in this present campaign he should feel indignant at John McSparren for accusing him of having double-crossed Taft and Sproul. Gifford is incapable of dirty tricks and no one knows it better than John McSparren. The latter is a graduate of Lafayette College and a fine man. He is a wonderfully persuasive speaker, fluent and full of fire. Before he gets through he will realize that success is not the greatest thing to be attained. A man may be defeated several times and come into his own at last, having gained greater power and influence than had he chosen the smaller part.

In this campaign one of our planks was in favor of local option. I was anxious to speak on this issue, but the managers forbade it. At Summit Hill I got permission to go ahead, and drove up in front of a saloon on a Saturday night. They all poured out and began shouting: "We want whiskey." I said: "All right, you can have your whiskey, but listen." I told them that I was proud of being an American citizen; Americans were a goot lot; you are a good lot, for you have one of the best school houses in the state. You are unselfish, for you not only clothe your children and send them to school, but you are most of you paying life insurance. You are a good lot of fellows, but you are mighty careless, for after you have spent all this money and care in educating your boys you turn them out on the street, and here is a saloon and there is a saloon to undo all you have done. Don't you think you are careless?

Metallurgy

Dr. Drown was a graduate of the Freiburg Mining Academy and much interested in everything pertaining to metallurgy. I became a member of the Institute of Mining Engineers in 1881 and attended many meetings. In this way and by visits to the different plants in vacation time I learned something, not much, about metallurgy. This was a good thing for me, for I was forced to teach it for several years. I became acquainted with Jerome Boyer, of Reading, and his friend, Mickley, of Hokendauqua, and with the Thomases and their superintendent, B. F. Fackenthal, whose acquaintance I made while he was superintendent at Durham Furnace. I also saw something of John Fritz and a good deal of James Gayley.

Leaders in Oil Shale Development

At the Third National Oil Shale Meeting, held in conjunction with the 25th annual convention of the American Mining Congress at Cleveland, Ohio, Oct. 9-14, under the chairmanship of Victor C. Alderson, president, Colorado School of Mines, Golden, Colo., the following resolutions were adopted:

Whereas, it is the desire of the Oil Shale Section of the American Mining Congress, that the development of the oil shale industry be undertaken along lines which will merit the confidence and respect of the country at large; and,

Whereas, the development of said industry will depend in a large degree upon the acquisition and maintenance of unquestionable titles to oil shale lands, and second, upon the solution of the problems connected with the mining and retorting of the shale and the refining and marketing of the products derived therefrom; and,

Whereas, the most economical and substantial development will be had through mutual cooperation and research in connection with the fundamental problems of the industry; and,

Whereas, fake promotion schemes have been and will continue to be a menace to the oil shale industry if permitted to exist; and,

Whereas, the Government of the United States can substantially aid in the solution of the various questions and problems involved in the development of the oil shale industry.

Now therefore, be it Resolved:

(1) That the various owners and holders of oil shale placer locations be encouraged to maintain and perfect their titles to the lands included in their said locations.

(2) That the Department of the Interior be urged to define specifically what character of labor and improvements shall be acceptable as annual labor, and that the Department in defining such annual labor, so define it that the work to be done will be of substantial value in the development of the property and of lasting benefit to the industry.

(3) That the Federal Government be urged to provide funds which will permit the Bureau of Mines and the Geological Survey to carry on and further expand research in connection with oil shales which is so vital and necessary to the forward [illegible]

(4) That the Federal Government provide funds sufficient to permit the General Land Office to re-survey those townships in the oil shale area for which the surveys have been incomplete or confusing.

(5) That ever member of the Oil Shale Section, and every person interested in the welfare of Oil Shale, be urged to use their every effort, individually and collectively, to prevent the promotion of fake oil shale schemes by reporting all organizations of any kind entering the Oil Shale field to the Promotions [illegible] of such cases; that the Promotions Investigating Committee be [illegible] with such schemes as may be reported, and which said committee shall make thorough investigations based upon any such reports, and make suitable recommendations to the proper legal authorities.

Reports were received from committees whose subjects and personnel are as follows:

I. EDUCATION
- Frank A. Wadleigh, Equitable Bldg., Denver, Colo.
- Walter Walker, Editor, *The Sentinel*, Grand Junction, Colo.
- S. E. Barnwell, Emery Hotel, Cincinnati, Ohio.
- Anson S. Blake, Balboa Bldg., San Francisco, Calif.
- Joseph Bellis, Grand Valley, Colo.

II. LEGISLATION, TITLE, AND ASSESSMENT WORK
- Tyson S. Dines, 195 High St., Denver, Colo.
- D. D. Potter, 605 E. & C. Bldg., Denver, Colo.
- Karl C. Schuyler, First Nat. Bank Bldg., Denver, Colo.
- Rea. L. Eaton, Glenwood Springs, Colo.
- Robt. D. Hawley, 605 E. & C. Bldg., Denver, Colo.

III. EXPLORATION AND DEVELOPMENT
- E. B. Brumsted, 908 Insurance Bldg., San Francisco, Calif.
- Prof. Edw. N. Canine, East Chicago, Ind.
- J. C. Howard, Utah Oil Ref. Co., Salt Lake City, Utah.
- S. M. Felton, Jr., Pure Oil Co., No. 2040 S. Michigan Ave., Chicago, Ill.

IV. MINING
- W. C. Russell, 605 E. & C. Bldg., Denver, Colo.
- H. A. Hansen, DeBeque, Colo.
- R. D. Burnham, Union Oil Bldg., Los Angeles, Calif.
- J. A. Ede, La Salle, Ill.

V. CRUSHING AND RETORTING
- L. B. Skinner, 1070 Humboldt St., Denver, Colo.
- E. J. Schraeder, Jr., Majestic Bldg., Chicago, Ill.
- J. B. Jones, 523 Dwight Bldg., Kansas City, Mo.
- R. M. Catlin, Franklin, N. J.
- W. C. Kirkpatrick, Majestic Bldg., Chicago, Ill.
- Prof. R. H. McKee, Columbia University, New York, N.Y.
- J. D. Newbery, 42 Root Bldg., Buffalo, N. Y.

VI. REFINING
- Dr. A. H. Low, Colorado School of Mines, Golden, Colo.
- C. L. Jones, Mellon Institute, University of Pittsburgh, Pittsburgh, Pa.
- E. E. Lyder, Elko, Nevada, care Catlin Shale Prod. Co.
- Prof. A. J. Franks, Colorado School of Mines, Golden, Colo.
- E. I. Dyer, Union Oil Bldg., Los Angeles, Calif.
- R. H. Brownlee, Benedum Trees Bldg., Pittsburgh, Pa.

VII. PROMOTION AND ORGANIZATION
- Col. E. D. Milliken, 506 First Nat. Bank Bldg., Denver, Colo.
- Leslie H. Webb, V. P. Wedge Mech. Furnace Co., Philadelphia, Pa.
- R. P. Ralston, 4th National Bank Bldg., Wichita, Kans.
- F. H. Wichett, Com. Exch. Bank Bldg., Chicago, Ill.

VIII. SPECIAL ECONOMIC USES OF SHALE OIL, ITS PRODUCTS AND RESIDUE
- Kirby Thomas, Rm. 704, 25 Broadway, New York, N. Y.
- Gov. Emmet D. Boyle, Carson City, Nevada.
- S. A. Ionides, 824 Equitable Bldg., Denver, Colo.
- Otto Stalmann, 319 Ness Bldg., Salt Lake City, Utah.
- Prof. W. K. Kirby, Colorado School of Mines, Golden, Colo.

IX. PROMOTIONS INVESTIGATING COMMITTEE
- Otto L. Hankison, 823 Ohio Bldg., Toledo, Ohio.
- Wm. D. Waltman, 422 First Nat. Bank Bldg., Denver, Colo.
- A. M. Gillespie, 42 Root Bldg., Buffalo, N. Y.
- C. A. Gillette, Salt Lake City, Utah.

E. H. Doherty, formerly of the Sweet Orchard Co., LaSalle, Ill., has been appointed research chemist, Ralston Purina Co., St. Louis, Mo.

* * *

Glenn E. Pickard, 9 So. Clinton Street, Chicago, Ill., has discontinued his consulting laboratory at that address to go with the Midland Linseed Products Co., Minneapolis, Minn.

* * *

E. R. Wright, assistant manager, and F. C. Evans, and superintendent, Repauno Works, Gibbstown, N. J., of E. I. du Pont de Nemours & Co., have been transferred to the Barksdale, Ashland, Wis., plant

II. Copper and Copper Alloys in the Chemical and Allied Industries

By Wilkinson Stark

Chemical Engineer

THE principal uses of copper and brass tubing fall into three classes, viz., (1) for heat exchange media, (2) for conveying liquids, and (3) as an integral part of a manufactured article.

Heat Transference

In the first class is a great variety of machines using tubing as a heating or cooling element, as e. g., surface condensers; feed-water heaters; water storage heaters; instantaneous water heaters; air compressor intercoolers; oil heat exchangers; evaporators for boiler feed water, salt, sugar, and other solutions; milk coolers, etc.

The superior conductivity of copper and brass and their high resistance to corrosion, make their use a necessity in practically every case where tubing is used for the transmission of heat. Such liquids as attack brass or copper are an exception, e. g., ammonia; hence tubing for use in ammonia condensers, generally iron, is sometimes lead-lined. Sulphuric acid in any concentration will attack both brass and iron. However, in low concentrations, brass has stood up very well, while iron succumbs quickly. In high concentrations, the reverse is the case, and in very high concentrations, it is necessary to use lead. In the case of many other corrosive liquids, individual studies must be made, striking a balance between possible increased life of the brass or copper as against greater first cost.

In condenser practice, the selection of the proper alloy is very important. Besides copper, four standard alloys are used for condenser tubes: (1) Muntz metal (60% copper, 40% zinc); two-and-one (60% copper, 33% zinc, and a small quantity of lead); seventy-thirty (70% copper, 30% zinc); and Admiralty metal (70% copper, 29% zinc, and 1% tin). Admiralty metal withstands corrosion better than the other alloys and should be used wherever the circulating water is salty or polluted with sewage or free acids. Muntz metal, the least resistant alloy, gives satisfatcory service only in clean, fresh water. There is a difference of less than 10 per cent in price between Muntz metal, the cheapest alloy, and Admiralty metal or copper, the most expensive.

Some idea of the amount of tubing used in surface condensers may be gleaned from the following: Between Jan. 1 and Oct 1, 1922, a prominent engineering company of New York City has submitted estimates on 28 surface-condensing units of over 30,000 sq. ft. per unit, totaling about 1,200,000 sq. ft. Translated into pounds of one inch, No. 18-guage tubing, we have a total of 2,500,000 lbs. or 90,000 lbs. per unit. This total represents about 1,700,000 lbs. of copper. Probably the greatest amount of evaporating surface is represented in the sugar industry. A typical central, consisting of quadruple-effect standard calandria-type evaporators, juice-heaters, defecators, etc., would require close to 150,000 lbs. of copper tubing, exclusive of supply lines.

During the war period, due to inability to secure copper, steel tubes occasionally were substituted, but they are never satisfactory due to low heat conductivity, greater susceptibility to corrosion from the cane juices or from acids used for "boiling out." It also is difficult to keep steel tubes tight at the joints, but comparatively easy with the more malleable and ductile copper. Moreover, corrosion of iron in sugar refining would cause discoloration of the sugar crystals. Copper tubing is standard practise.

In the case of oil heat exchangers, considerable free sulphuric acid is present. It is necessary, therefore, to use the highest grade of tube possible and, consequently, the use of Admiralty metal has become standard. Since copper tubing is more ductile than brass, it is generally used where the tubing is to be wound into coils, such as in instantaneous water heaters where a ¾-in. No. 19 or 20-guage soft copper tube is used. Since iron or steel cannot be used in contact with milk, all tubing required must be of copper. This tubing is heavily tinned with pure tin. Iron not only would corrode under the action of lactic acid, but would discolor the milk.

Copper tubing is largely used in Europe and the British colonies for locomotive boiler tubes, while in South America and Australia, brass is most largely used for this purpose. This practise has not been followed in this country, but should receive attention. An English railway authority claims that a life of 240,000-360,000 miles is obtained with copper tubes as against 80,000-120,000 miles with steel. In addition to this superior service are the higher heat conductivity of copper tubing and a scrap recovery value much greater relatively to the original cost than that of steel.

Transfer of Liquids

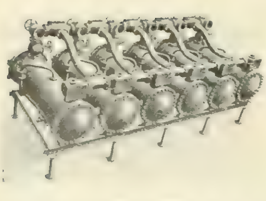
Among the uses of copper and copper-alloy tubing for supply lines are the following important examples: hot and cold water supply lines in buildings, factories and for industrial uses; boiler feed-water lines; steam or water lines on board ship; tubing or piping carrying corrosive liquids as, e. g., salt water, water containing free sulphuric acid, sugar solutions, milk, beer, tannic acid, tartaric acid, boracic acid, etc.

The most important use of copper is in water supply lines. We find in use iron or steel, either plain or galvanized, and lead-lined iron or plain lead. Due largely to the danger of lead poisoning, lead is little used today for this purpose. Lead, however, has no structural strength in itself, and when used as a lining in iron pipe, trouble results through the separation of the linings, permitting moisture to get between the lead and iron. Galvanized iron, the greatest competitor of brass, will last from 10-20 years depending upon use either in hot or cold circulating systems, and the nature of the water. The life of brass, on the other hand, is practically indefinite. We have two cases in mind, one where brass pipe in service 30 years was reinstalled upon alteration of the building, and another where iron pipe was removed from the hot water lines of a Riverside Drive apartment house in less than 10 years and brass substituted.

It is estimated that the average additional cost of brass over iron piping for hot water plumbing amounts to only 3½ mills on the dollar where the entire plumbing cost (pipe material and installation) amounts to

---

The initial article of this series in [illegible] CHEMICAL AGE considered briefly the history, metallurgy and economic position of copper. Following the present [illegible] of the [illegible]vity of copper and brass and their uses in the chemical and building industries will be the final article on the resistivity and uses of bronze.—Wilkinson Stark.

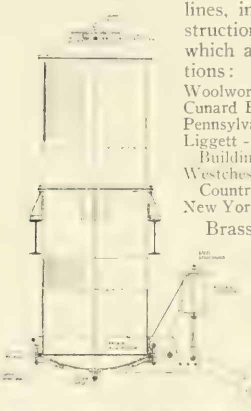


A unit of 2 sextuple-effect evaporators, mechanical film type, in U. S. battleships Tennessee and California. Wheeler Condenser & Engineering Co., 149 Broadway, New York. Capacity, 120 tons distilled water daily. Only copper and bronze used. Weight, 15 tons, ¾ that of cast iron.

6c on the dollar. This is on the assumption that the cost of installations for both brass and iron piping systems is the same, which rule should obtain. On a $10,000 building, this increase amounts to only $35.

Brass pipe is being accorded rapidly growing recognition as the best practise, particularly for hot water lines, in high-class building construction, typical examples of which are the following installations:

Woolworth Building	180,000 lbs.
Cunard Building	50,000 "
Pennsylvania Hotel	90,000 "
Liggett - Winchester - Ley Building	30,000 "
Westchester - Biltmore Country Club	30,000 "
New York Co. Court House	60,000 "



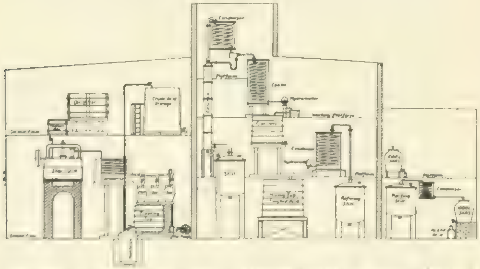
Copper autoclave for extraction of logwood, tanning extracts, etc., with modification, adapted for fat-splitting, etc. Geo. F. Ott Co., Philadelphia, Pa.

Brass piping is very durable, whereas iron piping, especially in a hot-water circulating system, begins to corrode at once and often has to be replaced within a period of 10-15 years. Since the total plumbing cost is estimated at 6c. on the dollar, it is fair to assume that the total installation cost amounts to 3c. on the dollar, or $300 on a $10,000 building. Of this 3c., 1½c. would be the installation cost of the hot water system or $150 for a $10,000 building. Therefore, by the selection of such a durable material as brass, a saving is made at the present market price of brass and iron pipe of this $150 each 10 or 15 years by the initial expenditure of $35, not to mention other advantages such as the elimination of incidental damage to ceilings and fixtures, the inconvenience that such replacement causes, and the satisfaction of having a water supply free from rust at all times.

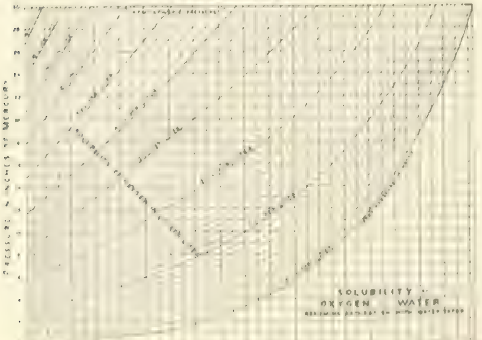
There is another consideration to be taken into account in any comparison of the respective merits of brass and iron piping. If the needs of the system, for instance, call for the volume of water that is carried by a 1-in. pipe, and iron pipe is decided upon, it is well, in such a case, to install a pipe of at least 1½-in. inside diameter. This is because, in the course of a few years, the iron pipe will become so filled with deposits of rust and other incrustations caused by corrosion that the diameter of the pipe, and consequently its capacity, will be constantly decreased. This additional size of iron pipe required to perform a given service, practically wipes out any price advantage of the iron pipe. No such condition as described above, occurs when brass or copper pipe are used. Such incrustation, of course, is not continuous or uniform, but the capacity of a pipe is determined by its smallest diameter and its durability by the strength of its weakest part.

With such advantages in favor of brass piping, and with the insurance against replacement and the attendant evils caused thereby at such a low premium rate, it is economy for the property owner generally to select the material which is most nearly permanent in its resistance to corrosive action. It is estimated that the annual loss occurring from corrosion in domestic hot water systems in the United States alone, amounts to $50,000,000.

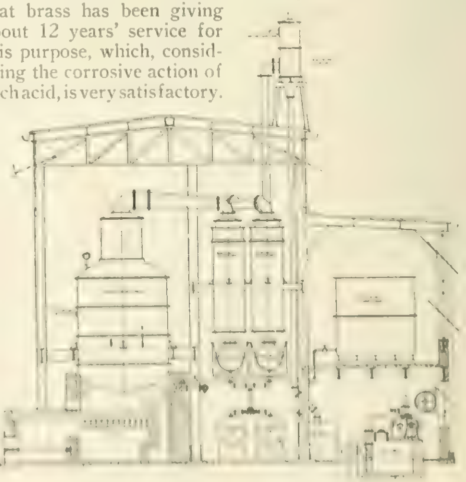
Another interesting use of brass pipe is in the conveyance of sludge acids. In the Bayway and Bayonne refineries of the Standard Oil Co. of N. J., sludge acid of about 30° Be., corresponding to about 50 per cent sulphuric acid, is conveyed from the refineries to an acid-reclaiming plant. For this purpose, the Bayway refinery has an installation of 10,000 ft. of 4-in. line; 2,200 ft. of the same diameter is installed at Bayonne. It is stated that brass has been giving about 12 years' service for this purpose, which, considering the corrosive action of such acid, is very satisfactory.



[illegible] plant. Storage tanks of wood; jars of [illegible] copper. Geo. F. Ott Co., Philadelphia, Pa.



[illegible]



[illegible]

The use of copper and brass tubing in manufactured articles or machines covers too wide a field to be discussed here. The reason for its use in almost infinite variety of applications arises from any one of the following properties, viz.: (1) high resistance to corrosion; (2) high heat conductivity; (3) high electrical conductivity; (4) high ductility and malleability coupled with fair tensile strength.

Corrosion of Metals

Corrosion is the partial or total destruction of metal materials by chemical or electrochemical action or both. We are concerned here only with the simple corrosion or oxidation of metals in the presence of water which contains the usual amount of air, and hence of oxygen, at atmospheric pressure and at various temperatures. More specifically, we will deal with the comparative resistance to corrosion of copper, brass and iron piping in the plumbing systems as usually installed in buildings.

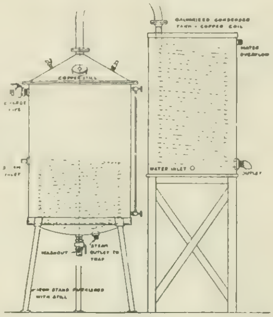
Water at ordinary atmospheric pressure and temperature contains about 4 per cent of air by volume, of which amount about 25 per cent is oxygen, or 1 per cent of oxygen to 99 per cent of water. Chart I gives the amounts of dissolved oxygen in water at various temperatures and pressures.* The oxygen-content varies according to the method of pumping and the amount of aeration before the water enters the system for distribution. New York City water, *e.g.*, is well aerated before entering the aqueducts. Chemical analysis of water from the Catskill Reservoir shows the following composition:

	Parts per Million		Parts per Million
Dissolved oxygen at 43°F.	12.8	Water of Crystallization (H_2O)	4.0
Calcium Carbonate ($CaCO_3$)	13.0	Organic Matter and Undetermined	11.0
Magnesium Sulphate ($MgSO_4$)	4.0	Total Solids	36.0
Sodium Chloride ($NaCl$)	2.0	Carbonic Acid Free (CO_2)	1.0
Potassium Nitrate (KNO_3)	1.0	Half-bound Carbonic Acid (CO_2)	6.0
Silicon Dioxide (SiO_2)	1.0		

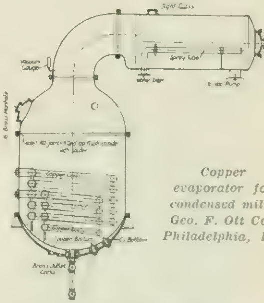
This is an unusually pure water.* Fairly pure water free of oxygen has little or no corrosive action on any of the metals. Therefore, to insure the longest life to pipes used for plumbing, it is necessary either to deoxygenate the water before it enters the closed system, or to select those metals which are most resistant to its corrosive action. Equipment on the market designed to deoxygenate water may be suitable for large buildings, but it is not deemed practical in small installations. For such, there remains, therefore, only the alternative of selecting piping which is most durable.

The corrosive action of water on metals may be described briefly as follows: The metal dissolves in the water at the rate and to the extent of its potential solubility and combines with the hydroxyl radical of water forming a metallous hydroxide and nascent hydrogen. This hydrogen, due to slight electric currents set up in the particles of the

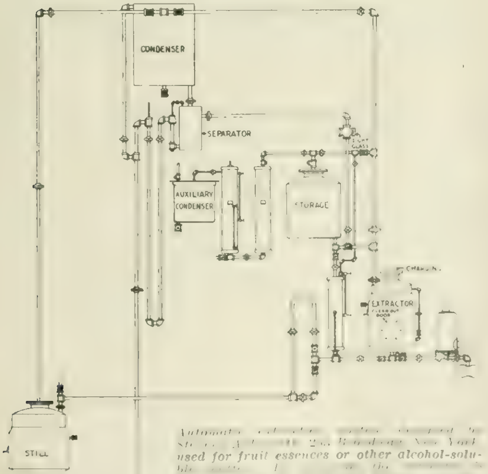
Triple-effect evaporator typical of apparatus of wide use for concentration of solutions of sugar, salt, malt, beef and tanning extracts, etc. Superior durability of copper insures lowest cost from standpoint of service. Geo. F. Ott Co., Philadelphia, Pa.


GALVANIZED CONDENSER TANK - COPPER COIL
WATER OVERFLOW
COPPER STILL
WATER INLET
OUTLET
WASHOUT
STEAM OUTLET TO TRAP
IRON STAND FURNISHED WITH STILL

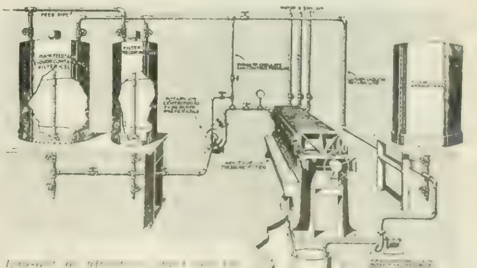
System for recovery of solvents used in dry-cleaning. Geo. F. Ott Co., Philadelphia, Pa.



Copper evaporator for condensed milk. Geo. F. Ott Co., Philadelphia, Pa.



Automatic extraction system designed by [illegible] Broadway, New York, used for fruit essences or other alcohol-soluble [illegible] from storage tank, which, when of suitable concentration, is transferred to the still, from which it is expelled to be condensed and separated [illegible] Operation is continuous until solvent supply is cut off from extractor [illegible]



[illegible] holic extracts, cereal beverages, etc. Material to be filtered is treated [illegible] the main feed tank with decoloriz[illegible] After filtration it is elevated from [illegible]

---

[*] Jour. of Ind. & Eng. Chem., July, 1922.

[*]Analysis from New York City Bureau of Water Supply

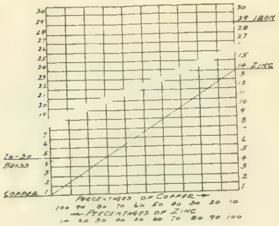
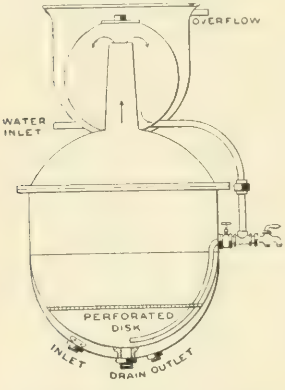
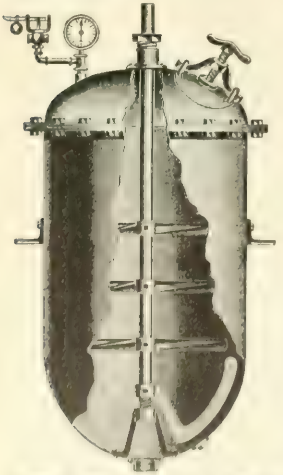


Chart II. Indicia of Corrodibility of Copper, Brass, Zinc and Iron.



Copper Steam-Jacketed Extractor with Dome Condenser. Used for extracting vanilla, aconite, belladonna, certain perfume extracts, etc. The extractor is surmounted by a globular surface condenser surrounded by a water-jacket. The material to be extracted is supported on a perforated copper disk. Circulation of the solvent is provided as indicated; when the required strength is attained it is withdrawn through suitable valves. T. Burkhart Co., Brooklyn, N. Y.



[illegible] lyn, N. Y.

metal, tends to plate on the cathode, or negative pole, of the battery thus formed; the water acting as an electrolyte. Being in the nascent, or active state, however, the hydrogen combines at once with the free oxygen present to form more water and the action is repeated so long as raw water is added to the system. The metallous hydroxide, due to a constantly replenished supply of oxygen, passes successively into the forms of metallic hydroxide, metallous oxide, and metallic oxide, which, in the case of iron or steel, is rust. Every pound of oxygen in the water may be responsible for at least 3 pounds of corrosion, which means that for every 1,000 gallons of water .25 lbs. of iron or steel is eaten away by such corrosion. Rust, being porous and to an extent soluble in water, the water attacks the new surface thus exposed and the action continues until the pipe is destroyed. This action, in the case of copper and brass, is not nearly so pronounced for the reason that the oxides of these metals are of a finer texture and are less soluble than the similar oxides of iron and, therefore, tend to coat the pipe and thus protect it from further action of the water.

Most waters contain a small quantity of acids and salts. Among the more common are carbonic acid, chlorides, carbonates, nitrates and sulphates. The action of some of these is to speed up corrosion, and of others to retard it; in cases where corrosion is augmented, this effect is greatly aided by the presence of free oxygen in the water.

Since we are concerned here with the comparative resistance of copper, brass and iron to oxidation, we may omit consideration of the action of these compounds because they vary greatly in character and content in different waters, whereas the content of oxygen is fairly constant in all waters at ordinary temperatures and pressures.

It, thus, is obvious that the determining factor in corrosion (oxidation) is the initial solubility of the metal in water. This is the first step upon which all succeeding combinations depend, so if we can determine the solubility factor of the different metals, we have the comparative basis of their resistance and consequently of their longevity, other things being equal and variables (salts and acids) disregarded. While the initial solubility of the metals in water, with its usual oxygen content, should not be construed as the absolute and final index as to their corrodibility, it is maintained that this is the only comparison possible since they are constants and the other corroding agents are variables.*

Tin is the most resistant of commonly used metals to corrosion by water; bronze (copper-tin) comes next, followed in turn by copper, brass (copper-zinc), zinc and iron. Chart II indicates the relative resistance to corrosion of copper, brass, zinc and iron in pure water saturated with oxygen, assuming perfect blending of the alloy and fineness of grain equal to that of the two constituent metals. Segregation of the constituent metals would lessen the resistance of the alloy as a whole where one metal is more subject to corrosion than the other; coarseness of grain materially adds to the corrodibility of both true metals and alloys.

Accepting solubility factors of 1 for copper, 5 for brass (70 Cu.-30 Zn.), 14 for zinc and 29 for iron, Chart II shows that copper is 1/29, a (70 Cu.-30 Zn.) brass is 5/29, and zinc is 14/29 as corrodible as iron; conversely that copper is 29 times, a 70-30 brass almost six times and zinc a little more than twice as durable as iron.

---

*"100 c.c. distilled water dissolves 1 mg. from 11.8 sq. cm. of copper in one week while air free of CO_2 is passed through the solution. 100 c.c. distilled water dissolves 29 mg. from 11.8 sq. cm. of iron in one week while air free from CO_2 is passed through the solution. 100 c.c. distilled water dissolves 14 mg. from 11.8 sq. cm. of zinc in one week while air free from CO_2 is passed through the solution. Tin is not attacked by distilled water when air is passed through it for a week."—Dictionary of Chemical Solubilities—Comey & Hahn (The MacMillan Co., N. Y.)

Calumet Baking Powder Co., Chicago, Ill., will double its present plant capacity by a 5-story 100 x 200 addition to cost $300,000.

* * *

With the concentration of manufacture of the Natl. Aniline & Chemical Co., at its Buffalo plant, the Marcus Hook, Pa., plant has been turned over to the Barrett Co. for the production of naphthalene.

* * *

Dr. C. R. Flint, former president, Cornell College, Mt. Vernon, Ia., on Nov. 17, was inducted into the Chancellorship of Syracuse University, Syracuse, N. Y., to succeed Dr. James R. Day, who served the institution for 29 years.

* * *

The public spirit of administrative men of the Warner Chemical Co., [illegible] Vanderbilt Avenue, New York, is evidenced by the election of S. C. Mastick, vice president, to state senate from the 26th district, Westchester Co., New York, and Louis Neuberg, manager Carteret, N. J., plant, as committeeman at large of Woodbridge, N. J., township.

Current Chemical Patents and Patent Problems

By Lloyd Van Doren, Ph.D.
Consulting Chemist; Patent Attorney, Duell, Warfield & Duell

IT often arises that the inventor desires to transfer interest in his invention, either entirely or in part, to another party. To effect this transfer, an instrument of assignment is drawn up in accordance with the terms of which, if it is an entire conveyance, the inventor transfers to a second party the whole right, title and interest in his invention for the United States and, in many instances, granting the right to secure protection in foreign countries. The assignment may be made prior to or subsequent to the grant of the patent. If the assignment is given subsequent to the grant of the patent, it should be distinctly borne in mind that to make the assignment valid it is necessary that the same shall be recorded within three months from its date; otherwise it will be void as against any subsequent purchaser for a valuable consideration without notice, unless it should so happen that the assignment becomes a matter of record prior to the subsequent purchase. Therefore, the assignee takes a decided chance if he does not record the assignment within three months from its date.

It is commonly thought that an assignment pertaining to an application for patent also must be recorded within three months. This, however, does not appear to be the fact, inasmuch as an assignment of an application may be made at any time prior to or on the day of final payment of the fee; thereupon the patent will issue, if so requested, to the assignee. The date of recording any assignment is the date at which the instrument is received at the Patent Office in proper form and accompanied by the full legal fee. The assignment of an application for patent, and the granting of a patent in accordance therewtih, usually causes little difficulty. However, should an inventor for some reason best known to himself decide to execute two assignments to different parties, and both parties present their assignments for record prior to the issue of patent, then it becomes a question as to whom the patent should issue. It seems only logical that the dates of execution of the assignments should control and, a determination made thereon, the award go to the party having the prior interest. However, this is not the present day practice before the Patent Office.

Conflicting Assignments

Such a condition as outlined gives rise to what is known as "conflicting assignments." When such conflicting assignments appear upon the records the Patent Office does not act in any capacity other than that of a ministerial one, and, accordingly, makes no determination of title and grants the patent to neither assignee, but to the inventor, thus leaving the question of title and ownership to the courts to decide. The position taken by the Patent Office and the reasons therefor are set forth in the case of Moller, 108 O. G. 2144, Commissioner's Decision 1904, p. 70, which decision reads as follows:

"Allen, Commissioner:

"This is a petition by Frederika Moller that the patent upon the above-entitled application be issued to her as assignee instead of to the inventor. It appears from the assignment records that an assignment was executed by the inventor on September 8, 1903, identifying the above-entitled application and transferring the entire interest to Frederika Moller. It requested that the patent issue to the assignee, and it was recorded on September 14, 1903 Liber C 68, 235. The records [illegible] further that on December [illegible] 1903 [illegible] inventor executed an assignment of the entire interest in the above-entitled application to The Mull Chocolate Machine Co., and in the instrument requested that the patent issue to the assignee. That assignment was recorded December 21, 1903, Liber U. 68, 184.

"Either one of the assignments if standing alone would be regarded as conveying the legal title to the assignee named therein and would have been accepted as authority in such assignee to proescute the application and receive the patent. Since, however, there are two inconsistent assignments, the Office cannot recognize and act upon one without disregarding the other. In the case of such conflict it has been the practice of the Office to refuse to pass upon the question which party is the real owner and to issue the patent to the inventor. As was said by Commissioner Duell in *ex parte McTammany* (C. D., 1900, 168; 93 O. G., 751):

"'Where there are two or more assignments purporting to convey the exclusive right and in each there is a request that the patent issue to the asignee named therein the Office should not investigate the question of title and decide which assignee has the right to the invention and to prosecute the case, but the applicant should be permitted to prosecute it and to appoint an attorney of his own selection, the question which assignee has the right to the invention being left to the courts, where it properly belongs.'

"The petitioner contends that this practice is wrong and that the patent should issue in accordance with the assignment of earliest date. She argues that the first assignee has the *prima facie* right and that the Office should be guided in its action by that fact alone.

"This Office is not authorized to render binding decisions upon questions of title, and it uniformly refused to undertake to settle disputes in such matters, since it acts in a merely ministerial capacity in regard to assignments. (*Ex parte Spielmann*, C. D., 1892, 1; 58 O. G., 141; *ex parte Gallatin*, C. D., 1892, 106; 59 O. G., 1104; *ex parte McFarlane*, C. D., 1896, 37; 76 O. G., 1418.) While it cannot settle disputes as to title, it does not and should not disregard the fact that there is dispute. The law is not mandatory that the patent issue to the assignee in any case, and where there is dispute as to the ownership the Office is justified in issuing the patent to the inventor who made the application.

"The fact in the present case that the second assignment was executed and filed for record shows that the contention that the first assignment is in force is disputed, although the grounds of the dispute do not appear. It should be noted that the Office has no means of knowing whether the first assignment is valid or whether there is an assignment not recorded transferring the invention from the first assignee, Moller, back to the inventor, Mull.

"The suggestion is made on behalf of the petitioner that the practice of issuing the patent to the inventor in case of conflicing assignments furnishes means whereby an unscrupulous inventor may defraud his first assignee by making a second assignment. It should be noted, however, that the issuance of the patent to the inventor does not deprive the first assignee of his rights in the patent, if he is the rightful owner (*Gaylor* v. *Wilder*, 10 How., 477), but merely puts him to some inconvenience. As was said in *De la Vergne* v. *Featherstone* (C. D., 1893, 181; 62 O. G., 741; 147 U. S. 209):

"'A patent issued to an inventor after an assignment of his entire interest has been entered of record, immediately and by operation of law inures to the benefit of his assignee.'

"The second assignment puts the first assignee to some inconvenience even if the patent is issued to him, since it throws a cloud upon his title which it is necessary to clear in the courts. This Office cannot undertake to prevent fraudulent second assignments any more than to prevent fraud in any other assignments, but must leave that to the courts and the punishment there meted out. It is believed that justice is best secured, as a general rule, by issuing the patent to the inventor in case of conflicting assignments.

"The petition is denied."

The practice of the Patent Office in the light of conflicting assignments is further set forth in the Decision of Assistant Commissioner Moore, in the case of Sparkes v. Small, 113 O. G. 1970, Commissioner's decisions 1904, p. 547, to which attention is directed.

A Central Patent Office for the British Empire

To obtain a patent in all parts of the British Empire at least 46 separate applications have to be made and initial fees paid of £5 in the United Kingdom, £32 in the Dominions and India collectively, and about £250 for all the Colonies and Protectorates. Renewal fees amount to £126 for the United Kingdom, £84 for the Dominions and India collectively, and approximately £1,000 for the Colonies and Protectorates.

We are not surprised that at a recent conference at the patent office in London of representatives of patent offices throughout the Dominions, India and the Colonies and Protectorates, such a system was characterized as very unsatisfactory. The conference was called to consider the possibility of instituting a practical system of granting patents which should be valid throughout the British Empire. It was agreed unanimously that it was desirable, provided the autonomy of the self-governing Dominions and of India was preserved and that the existing rights and facilities of inventors were not affected, to institute a British Empire Patent as a means of cheapening cost and simplifying procedure. Various proposals were considered in detail and the following plan was adopted as having the greatest chance of general acceptance throughout the Empire:

(*a*) The existing rights of the United Kingdom, the self-governing Dominions, and India to grant patents in accordance with their laws and within their own territories to be maintained in full.

(*b*) The establishment of a Central Patent Office for the reception and examination of applications for, and the grant of, patents which shall extend to the United Kingdom, or to any of the self-governing Dominions, or to India, upon registration in the particular territory in which protection is desired. The application for registration to be open to opposition before registration is actually effected.

(*c*) The Central Patent Office, in examining applications submitted to it, to make a search co-extensive with the field at present covered by the searches now made in the United Kingdom, the self-governing Dominions and India collectively.

(*d*) The scheme suggested above to be equally applicable to all the Colonies and Protectorates, subject to the qualification that the application for registration shall not be open to opposition unless the existing law makes provision for the hearing of opposition to the grant of patents, but in any case the local courts to be empowered to declare that an exclusive privilege has not been secured in the territories within their jurisdiction.

(*e*) The fees for registration to be of such amount as would result in a considerable reduction in the total cost of obtaining patents throughout the Empire at the present time.

Advantages of Centralized Control

One application and one specification only will be necessary for obtaining the grant of a patent throughout the British Empire. There will be one examination in respect of formalities, the sufficiency of the documents, and the novelty of the invention, and consequently after the application in the Central Office has been accepted there will be less uncertainty as to the fate of the application throughout the British Empire. There will be, in consequence, a very great diminution of expense, both in regard to the preparation supply, and printing of documents, and as a result of the abolition of the local examination on each application. There probably will be a very considerable diminution in agency fees. The establishment of such a system will reduce the overlapping of functions in the various offices and tend to prevent the multiplication of expensive machinery for examination into novelty. Finally, the establishment of any such Imperial system will create a further bond of union between the various parts of the British Empire.

In view of the difficulty of equipping a Central Office with all the necessary material for extended examination and of the time and expense which necessarily would be involved, a provisional "preferred" plan was recommended, whereby, provided the Dominion Patent Offices retained the right to raise an objection before registration on the ground of anticipation in locally granted patents or of prior local publication or user, patents as at present granted by the Patent Office of the United Kingdom should be accepted for registration throughout the Empire.

While the conditions throughout the British Empire differ greatly from those of the various possessions of the United States, nevertheless there is a certain similarity. With the acceptance of the "preferred" plan and the inauguration of a Central Patent Office the procedure then will conform closely to that in force here, in that under the present practice a United States patent grant extends the exclusive privileges not only within the territorial limits of the United States, but to all of its possessions, with the additional procedure necessary of registration in Porto Rico and the Philippines.

German Patent Fees

During the past summer, fees payable for registration of patents, trademarks and industrial designs in Germany were materially increased. The annuity fees for patents now amount to 300 paper marks for each of the first two years; subsequently the annuities increase progressively to the fifteenth year, at which time the fee amounts to 20,000 marks. For designs, a registration fee of 200 marks is charged, and upon the payment of 1,000 marks additional, the protection will be extended beyond the initial three years. An application fee of 200 marks for trademark registrations is charged for the first class of goods for which the trademark is used, and 100 marks for each additional class. 300 marks is set as the renewal fee for a single class of trademarks, and 100 marks for each additional class.

Paracoumaron Resin in Flake Form

Paracoumaron resin obtained by polymerization of certain ingredients of coal-tar naphtha by treatment with sulphuric acid, aluminum chloride, or otherwise, may be of various degrees of hardness from a melting point of 50° C. or lower to about 150° C. or higher, depending largely upon the method of its manufacture. After the polymerization treatment of the naphtha to produce the resin, it is distilled to remove the lighter or low-boiling constituents, leaving the resin as a residue which is a liquid while hot. This hot liquid resin is sometimes run into shipping containers where it is allowed to harden and set. In such cases it is difficult to remove the resin from the container, often requiring the destruction or injury of the container and waste of some of the resin as it sticks to the sides and is lost. Instead of running the hot resin directly into the shipping containers, it may be run into bays or bins where it is allowed to harden and set, but in this case it may be broken up or dug out for shipment. This procedure also entails losses and expense, as the hard grades especially break up into lumps of various sizes and some of it becomes powdered and lost.

To facilitate the handling of this resin not only in its manufacture but in its use in varnish manufacture, as a rubber-filler, etc., S. P. Miller, the Barrett Co., Philadelphia, Pa., flakes it by immersing a chilling cylinder into the tank of molten resin, which on rotating carries up a fluid film of the resin, from which it is removed in flakes by a scraper. While this device is well known, Mr. Miller's invention, U. S. Patent 1,431,070, applies to the product obtained by the use of this device in a form never before produced. Obvious are the advantages of decreased production cost. Because of the tendency of resins of low melting points at ordinary temperatures to "run together" when flaked, more satisfactory results are obtained by this device with resins melting at 95° C. and higher.

Purification of Zirconium Ore

Zirconium oxide or ores of zirconium oxide have been used as refractories with considerable success. The material in the pure state has a very high melting point and has other desirable characteristics such as low heat conductivity. The pure oxide has a melting point of about 3000° C. However, it has been found very costly to purify crude zirconium oxide by means of chemical treatment and consequently, comparatively little of the pure oxide is being used for refractory purposes. Zirconium ores such as are commercially obtainable contain about 70 per cent of zirconium oxide and have a melting point of about 1,800° C. It is thus apparent that the refractoriness of this material depends upon the purity. Otis Hutchins of the Carborundum Co., Niagara Falls, N. Y., has found, U. S. Pat. No. 1,427,816, a relatively cheap method of purifying zirconium ores which consists of fusing the crude ore in an electric furnace in the presence of a reducing agent such as carbon when occurs a reduction to the metallic state of the iron oxide and silica along with a small portion of the zirconium oxide. These reduced metals form an alloy which can be separated from the fused oxides. As an illustration of this process, Mr. Hutchins has fused in an electric furnace a mixtures consisting of 95.5 per cent zirconium ore and [1]4.5 per cent of coke and [2]13.2 per cent of coke. The enrichment of the ore is shown by the following table:

COMPOSITION

	Ore	Fused Oxides ([1]4.5% coke)	Fused Oxides ([2]13.2% coke)
Ing. loss	2.8%	0.0	0.0
ZrO_2	64.9%	87.2	97.7
SiO_2	19.0%	7.7	.3
Fe_2O_3	7.5%	1.7	.2
TiO_2	1.1%	.5	.5

The product obtained from these fusions is a hard, dark-colored crystalline mass, thoroughly shrunk. It has a large field of application in the manufacture of refractory products. Under certain conditions it is desirable to add a certain amount of metallic iron to the mixture being fused in order to produce a metallic alloy having magnetic properties. This makes possible an easy separation of the metallic and non-metallic products by means of magnetic separators.

Lactate of Lime in Baking Powder

Effervescent mixtures used as leavening agents have consisted essentially of sodium-bicarbonate and an acid constituent which, in the presence of water or water-containing substances, acts upon the alkali and liberates carbonic acid gas. Bicarbonate of soda being easily available and satisfactory, most of the efforts in baking powder manufacture have been directed towards providing an acid constituent fulfilling and reconciling the practically conflicting attributes of low cost, effective liberation of gas, production of a reaction residue without injurious effect on the organism, stability when mixed with the bicarbonate, and properly timed reactivity with the bicarbonates for leavening purposes. Generally speaking, acid constituents heretofore used have attained one or more of these attributes at the expense of one or more of the others. Some baking powders comprising bicarbonates are not injurious, but expensive; others are cheap, but of doubtful or worse effect on the organism; others, which might be made both non-injurious and cheap, would not keep or not generate sufficient gas, and so on.

William E. Stokes, of the Royal Baking Powder Co., New York, has found that calcium lactate beside possessing the property of liberating CO_2 from bicarbonates has such qualities as make it an advantageous ingredient of leavening agents. In the reaction,

$$CaC_6H_{10}O_6 + 2\,NaHCO_3 = CaCO_3 + 2\,NaC_3H_5O_3 + H_2O + CO_2,$$

the residue is sodium lactate, $NaC_3H_5O_3$, a recognized food product. In practice, Mr. Stokes prefers to use calcium lactate in connection with mono-calcium phosphate, because of a secondary reaction, viz.:

$$CaH_4P_2O_8 + 2\,CaCO_3 = Ca_3P_2O_8 + 2\,CO_2 + 2\,H_2O$$

whereby the neutral and inert tri-calcium phosphate is produced.

Calcium acid phosphate has found a place in some baking powders, but such powders have not been satisfactory. In some instances, where the mixture has been of the phosphate, bicarbonate and filler, imperfect stability has resulted, notwithstanding improvements in the character of the phosphate made with that in view. In other instances, to correct this shortcoming, resort has been had to the addition of alum, with the result that the residue has been objectionable. The use of the neutral organic salt in connection with the phosphate makes, Mr. Stokes believes, for the first time, a phosphate baking powder of satisfactory stability.

The stability or keeping qualities of this baking powder may be explained in part by the fact that the organic salt acts as a filler, tending to keep the phosphate separated from the bicarbonate; and so it is preferred to use the fine particles of neutral calcium-lactate, together with coarse bicarbonate and phosphate. It is not improbable that there is also a chemical reason for the satisfactory result, having to do with the like qualities of the phosphate and the neutral organic salt. Whatever the explanation, test has shown that a baking powder consisting of a mixture of 6 parts calcium acid phosphate, 7 calcium-lactate, 7 bicarbonate of soda and 5 starch, has 14 per cent available gas and, after being exposed in an open dish to an atmosphere of maximum humidity at 98°F. continuously for 120 hours, lost less than 1.50 per cent, which approximates the loss under similar conditions of the highest grade and most expensive powders and represents much less loss than that of many well known baking powders under like conditions. It will be observed that this mixture has an exceptionally high percentage of available gas. In addition to its strength and keeping qualities, this mixture is well timed, partly because of the primary reaction followed by the secondary action, for leavening purposes, and is less expensive than other effervescent mixtures of comparable strength, stability and unobjectionableness.

Building Material from Corn Cobs

Dr. F. B. La Forge, organic chemist, Bureau of Chemistry, U. S. Department of Agriculture, estimates that 20 million tons of corn cobs are produced annually in America. Chemical research has indicated the fruitfulness of this material in compounds that have wide industrial applications (CHEMICAL AGE, September, 1920), Paul Gruber and H. C. Bashioum, Pittsburgh, Pa., U. S. Pat. No. 1,427,378, propose the use of corn cobs in the manufacture of a lumber substitute where high tensile strength is not required and which may be shaped by wood-working tools the same as lumber. To prevent injury to the corn cob fibres, treatment with chemicals is avoided if practicable. The ground cobs are sprinkled with water until saturated, after which they are cooked in a closed receptacle at a temperature ranging between 120 and 160° C. for one-half to two hours after digestion.

The resulting mass is pressed to remove the liquor.

The bulk of soluble colloidal material in the cob is carried off with this liquor. When the cobs have been treated thus without the use of chemicals, the colloidal matter expressed is a natural mucilage, which, when further evaporated, forms a useful adhesive. This same fluid, when further treated, may be made to yield certain sugars as well as furfural. When the cobs are subjected to the action of alkali, this useful colloidal matter is destroyed. Cooking with alkali has the advantage, however, of producing a fine white pulp.

In utilizing the flaky, fibrous mass resulting from pressing, a suitable binder is added and the whole thoroughly mixed at such temperatures as are determined by the nature of the binder and the use to be made of the product, whether to be pressed into forms in moulds or rolled into sheets. The present and dried moulded product is hard and of a weight approximating that of light wood and may be worked readily in a wood turning lathe, producing shavings and does not ordinarily chip. The material is very desirable for making spools, and it is estimated that they can be produced more cheaply than similar spools from birch wood. It is pleasing in appearance, and is adapted for a large number of other uses, such as picture frames and mouldings.

Instead of molding the pulp in a press, the mass of pulp and binder may be made more fluid and shaped with rolls to form a wall board of the desired thickness and width. A binder formed from casein, as sodium caseinate, produces a hard material having a minimum shrinkage, is substantially moisture proof, has a pleasing appearance, and may be readily turned on a lathe without chipping. The casein may be rendered waterproof by treatment with formaldehyde. Oxidizing oils, such as castor or linseed oils, may be introduced in a casein binder to increase the elasticity of the product. Glue and gelatin are also classed as a protein binder.

As other binders, depending on the use to which the material is to be put, may be used carbohydrates, as starch and hydrocelluloses; hydrocarbons of the asphaltum type, particularly useful in making a moisture-proof wallboard; resin binders including natural and synthetic resins, such as the well-known phenolic condensation products.

The natural adhesive contained in the cob and extracted after cooking, may, under some circumstances, be concentrated and used as the binder. In some instances, the cobs may be ground and cooked with water, after which excess moisture is removed by evaporation, and the natural adhesive remaining in the pulp may act as a binder. The material when formed with casein binder is hard and tough and will not split readily, although the properties of the product depend largely on the binder. For this reason, it can be drilled and fastening devices, such as nails and screws, may be driven therein with less danger of splitting than in wood.

Butyl Alcohol and Acetone by Fermentation

The joint production of butyl alcohol and acetone by fermentation, thus broadly stated, is old, but the processes hitherto proposed have had certain disadvantages which have rendered difficult their practice on a commercial scale. Thus considerable difficulty is encountered in the isolation and maintenance of pure active cultures of the particular species of bacteria used in fermentations of this kind, and in cases where this species was anaerobic both the apparatus and the process were complicated by the necessity of excluding air and, in some cases, of working under reduced pressure. George D. Horton, of E. I. du Pont de Nemours & Co., has devisd a butyl alcohol-acetone fermentation process wherein the bacteria to be used may be readily isolated and kept in a condition capable of causing active butyl alcohol and acetone fermentation when transferred into a suitable mash, and wherein the bacteria used are capable of causing vigorous fermentation of carbohydrates with good yields of butyl alcohol and acetone in the presence of air, thus avoiding the great disadvantages entailed when working with anaerobic bacteria. He has named these bacteria *Bacillus aceto-butylicum* and describes in U. S. Pat. No. 1,427,595 their isolation, and identification in accordance with the provisions of the Society of American Bacteriologists the *Bacillus aceto-butylicum* is capable of fermenting starch materials such as cornmeal in the presence of air with a high yield of butyl alcohol and acetone. The same fermentation, at least insofar as the production of butyl alcohol and acetone is concerned, is brought about in the absence of air. Consequently no effort need be made to insure the presence of air during the fermentation. The air ordinarily is excluded to a great extent by the evolution of gas from the fermenting mass, and, of course, air laden with bacteria is carefully excluded to prevent contamination. The advantage, however, in working with facultative anaerobes such as the *Bacillus aceto-butylicum*, that is, bacteria which live or ferment in either the presence or absence of air, is that it is frequently more convenient to avoid contamination by filtering the air than by excluding it entirely.

Mr. Horton has found that the fermentation of a 5 per cent cornmeal solution usually gives at least 18 per cent by weight of mixed butyl alcohol and acetone on the basis of the weight of the commercial cornmeal used, or considering the cornmeal to average 60 per cent starch, 30 per cent by weight of mixed products on the basis of the weight of the starch. There is but little difficulty in carrying out the operations with cornmeal and the yields are uniformly high. There has been no advantage in using concentrations of over 5 per cent cornmeal because the products of the fermentation inhibit and destroy further action of the organism after this amount of material has been utilized.

In carrying out the recovery of butyl alcohol and acetone, the fermented liquid is distilled in an iron still fitted with a steam coil. At 60° C., acetone starts coming over into the receiver and as the temperature rises to 91° C. the distiliate becomes cloudy due to the butyl alcohol and water coming over at that temperature as a constant boiling mixture. The temperature is carried to 100° C. to remove all the mixed products. The constant boiling mixture of butyl alcohol and water is found to be composed of 43 per cent water and 57 per cent butyl alcohol. This cannot be fractioned by distillation, but the greater part of the butyl alcohol which separates as a clear layer is separated mechanically. The butyl alcohol in the water is removed by redistillation. The acetone and butyl alcohol are finally obtained by fractionation in a small glass still fitted with a Hempel column. The proportion of butyl alcohol to acetone in yields from corn Mr. Horton has found to be about 2.14 to 1.

Fire Extinguisher from Waste Pulp Liquor

In the manufacture of paper from woodpulp the two most commonly used processes are the "soda" or alkaline process and the "sulphite" or acid process, the by-product therefrom termed "glutrin" or "pulp liquor" being of little or no commercial value. These glutrins are heavy, viscous liquors, the viscosity of which may be increased by evaporation. The extinguishment of fires, particularly in large oil tanks, has been very difficult. The usual agent of fire extinguishing, such as water, is of no use for such purpose; in fact, water has a [illegible] has been made, how- [illegible] by com- bining two chemicals, one portion being a solution of an extract [illegible] portion being an acid, usually sulphuric acid. Frequently, the first [illegible]

[illegible]

the oil surface and in that respect the blanket will be more effective to cut off the supporter of combination than in the case where the foam is weak and readily torn apart or broken up by the upward rush of the hot gases or flames, by the use of this by-product liquor which is cheap; in fact, is a drug on the market, and with which suitable chemicals may be mixed to produce the desired reaction to cause the foam to be formed. The extinguishing properties of the foam may be enhanced by the inclusion, in either or both liquid portions, of a suitable quantity of carbon tetrachloride. As an example, the adding of from one-half to 20 parts of carbon tetrachloride to about 100 parts of either or both solutions, to be mixed together, greatly increases the extinguishing properties of the foam. The carbon tetrachloride during the gas and foam formation, enters into the mass and when subjected to heat vaporizes into a heavy gas blanket thereby, with the foam itself, forming a sort of double blanket for excluding the supporter of combustion.

Hardening Rosin for Varnish Manufacture

Common rosin is used extensively in varnish-making and would be used far more extensively, were it not for inherent objectionable features that every practical varnish maker is familiar with, viz., its brittleness, acidity, tendency of a rosin varnish to lose its high luster and turn white when coming in contact with water. For the purpose of counteracting these drawbacks many attempts have been made to discover suitable compounds capable of combining chemically with rosin. For instance the use of quicklime has been resorted to more or less successfully. While it is true that quicklime acts upon rosin forming a lime resinate and thereby neutralizing the acidity, its use presents serious objections such as to cause its rejection, in cases particularly where a clear translucent varnish is desirable.

William H. Scheel of Mt. Vernon, N. Y., has found that in varnish-making, there is a vast difference between the lime such as obtained from ordinary limestone and the much whiter and purer material obtainable from the calcination in suitable kilns of coral limestone. Not only do they differ in physical characteristics, the coral lime being much purer and whiter, but the coral lime, owing to its peculiar structure, which is more like that of infusorial earth, diffuses more readily and the diffused particles combine more completely when agitated in molten rosin and even at a lower temperature; the result being clear and transparent, instead of being milky or cloudy resinate of lime. Attempts have been made to get less unsatisfactory results in hardening rosin, by the substitution of oyster shell lime in place of the common quicklime such as used as a material for building construction. But it has been found in the practice of hardening rosin in making cheap rosin varnishes, that the oyster shell lime seldom runs uniform in percentage of CaO, it is more or less dark colored from impurities such as cartilaginous matter, so that oyster shell lime had to be rejected as a material in a process where cleanliness should be the first consideration as it is the case of varnish making.

In hardening rosin with coral lime, Mr. Scheel first melts, U. S. Pat. No. 1,428.120, the rosin in a round bottom iron kettle, using direct fire, in preference to indirect heat and when the rosin has been thoroughly liquefied by heat, he adds to it, under constant stirring, one pound of coral lime in pulverized form. To facilitate diffusion of the pulverized coral lime, it is sifted through a fine mesh metallic sieve all over the surface of the liquefied rosin. It is found in practice that only one per cent in weight of the pulverized coral lime is sufficient to harden or neutralize 100 pounds of common rosin, but inasmuch as the various grades of rosin do not run uniform in their degree of acidity, departure from these proportions may be necessary. It requires about 30 minutes to treat a batch of 300 lbs. of rosin. The use of an iron rod tapering at the end to a spatula greatly facilitates the scraping from the bottom of the kettle. Having completed the operation after 30 minutes of cooking, the hardened rosin in a liquefied condition is transferred to an adjoining tray or cooling receptacle, where it solidifies in cooling. It is thus ready for use as the gummy or resinous material for the purpose of varnish making and in such manner or in such proportions as the varnish formula calls for.

Cork Substitute from Wood

[illegible]

the wood to a shapeless mass of pulp and to yield a product having the desired resiliency and mechanical strength. With the wood of the *Orchroma lagopus*, known in most tropical countries as the Balsa wood and in American Samoa as Fau which contains about 75 per cent of cellulose, satisfactory results may be obtained by removing from about 10-60 per cent of the non-cellulose materials. Usually the amount removed is about 25 per cent. Balsa wood is particularly suitable since it contains sap ducts through it and in general any wood having such sap ducts is particularly useful for treatment.

Emma E. Graham, Seattle, Wash., describes in U. S. Pat. No. 1,427,682, the process whereby wood is converted in a substitute for cork. The wood is first reduced on a lathe to the desired size and shape and then is immersed in a solution of 5 gallons of water to 1 pound of bicarbonate of soda, maintained at 180° F. for 6 to 12 hours according to the size of the pieces of wood treated. The pieces are then washed thoroughly for 10 minutes in clear water without reduction of temperature, whereupon they are soaked again for at least 10 hours in a 10 per cent solution of wood ash lye at the same temperature. After another thorough washing in clear water of 180° F., the pieces are dried without cooling. In thus treating wood to remove a portion of the non-cellulose materials a soft porous wood gives a product having more resiliency than that obtained by a hard close-grained wood. Further, not only is a more desirable product obtained from a soft porous wood, but such wood requires a shorter treatment than hard woods.

Henry Howard's Way of Making Aluminum Chloride

Aluminum chloride solution, produced, e. g., by dissolving aluminum hydrate in muriatic acid, cannot be evaporated to form the anhydrous aluminum chloride since on heating it splits up into Al_2O_3 and HCl. The aqueous solution, however, can be concentrated to a point where a crystalline product containing water of crystallization will be produced, corresponding to the formula $Al_2Cl_6.12H_2O$, and a small tonnage of this material is produced in order to save freight. Heretofore, however, it has not been easy to produce this salt owing to the difficulty in finding apparatus which will resist the action of boiling aluminum chloride solution. Enameled iron has only a short life. Duriron withstands the corrosive action better but is gradually dissolved and contaminates the crystals with iron, imparting to them an undesirable greenish color.

Henry Howard, Grasselli Chemical Co., Cleveland, Ohio, avails himself in part of the fact that crystalline aluminum chloride is nearly insoluble in hydrochloric acid to devise an improved way of producing aluminum chloride.

The basic aluminum chloride solution may be made in either of the well-known ways, e. g., by partially neutralizing the hydrochloric acid of aluminum chloride with sodium carbonate which still leaves the aluminum in solution, or it may be produced by dissolving an excess of aluminum hydrate in aluminum chloride. It is obviously preferable to use the second method as contamination of the solution of aluminum chloride is thereby avoided.

The aluminum chloride solution of 35° Be, or stronger, after settling or filtering, is saturated with hydrochloric acid gas which is readily absorbed and which causes the aluminum chloride to separate out in pure crystals. The gas is passed in until the supernatant liquor has an acidity of 30-35% HCl; in other words so that it will make a suitable acid for dissolving fresh portions of the hydrate of alumina. Under these conditions over 80% of the aluminum chloride originally present in the solution will be separated out as aluminum chloride crystals. The entire mass of crystals and liquor is then run onto a filter to separate the crystals. The filtrate, which is essentially muriatic acid, is then used for dissolving fresh portions of the aluminum hydrate, which provides the solution for a further operation.

The crystals recovered in the filter, which is preferably a covered tank having a false bottom of filtros tile, are contaminated with hydrochloric acid which clings to the crystals. This acid cannot be removed with water without dissolving the aluminum chloride crystals, but Howard has found it quite possible and highly practicable to neutralize the adhering acid, preferably by washing the crystals with a basic solution of aluminum chloride. For assisting in this operation the filter tank is provided with a stirrer. A strongly basic concentrated solution of aluminum chloride is introduced and the stirrer started; the bottom outlet of the filter tank being closed of course. The entire mass of crystals is thus brought into suspension as a slurry in the basic aluminum chloride solution.

In the crystal washing step scarcely any of the precipitated salts are dissolved. The free acid attached to the crystals is however instantly removed by combining with the basic alumina. The slurry is then run from the filter tank into a suitable rubber-lined centrifugal machine, which separates the neutral liquor from the neutral salts, leaving them white, nearly dry and ready to be packed for the market. The liquid effluent from the centrifugal machine is used for saturating with hydrochloric acid gas in the next operation. This completes the cycle.

Increased Flexibility of Celluloid Without Castor Oil

It has been known that when it was desired to make a variety of "celluloid" or similar substance having a high degree of flexibility, this end could be attained by the addition of castor oil. Thus, in addition to the usual ingredients of celluloid, viz., nitrocellulose and camphor, a more flexible variety could be obtained by the inclusion of a certain amount of castor oil. Compositions thus obtained may become rancid and some preservative has to be included to counteract this; also the presence of castor oil is apt to cause the composition to deteriorate rather rapidly and become weak and brittle. Castor oil has been used to confer flexibility on other plastic compositions made of nitrocellulose and tricresylphosphate.

Heretofore, in the preparation of a celluloid-like substance from nitrocellulose and tricresylphosphate, the proportions used have been usually about 100 parts of nitrocellulose and 30 to 50 parts of tricresylphosphate. This gives a firm celluloid-like substance when it is molded. Like celluloid it can be given an increased flexibility by the addition of castor oil. William G. Lindsay, of The Celluloid Co., Newark, N. J., has found, U. S. Pat. 1,430,020, that by greatly increasing the proportion of tricresylphosphate and not using any castor oil that the desired flexibility is attained.

In carrying out the process Mr. Lindsay first wets the nitrocellulose (100 parts) and then works in the tricresylphosphate (40 parts) until a homeogeneous plastic mass results. He then extracts the moisture and adds a small proportion of a suitable pyroxylin solvent, which also will dissolve the tricresylphosphate, as acetone, alcohol, ether, etc., and works in 100 parts additional of tricresylphosphate on kneading rolls until a homogeneous mass is obtained and then presses it into a solid block of a yielding, flexible character like india rubber. If sheets of any thickness are desired, they may be shaved from this block by shaving machines in the same manner as from "celluloid" blocks, or by dissolving the product in volatile solvents flowing and evaporating the latter in the usual manner.

The proportions of tricresylphosphate can be increased to 600 parts to 100 parts of nitrocellulose to obtain the flexibility desired, or triphenyl or any other aromatic phosphate may be substituted. This composition has many applications. By using a large quantity of solvent it can be obtained in liquid form and then brushed upon fabric or other surfaces like a varnish and when the solvent dries out the flexible coating will remain closely adherent to the surface. It can be molded and pressed into various desired shapes. Blocks of this composition may be used for cushion buffers.

By using a suitable fabric and suitable thickness of this material, Mr. Lindsay produces superior varieties of so-called artificial leather and the surface can be stamped in imitation of morocco or alligator skin or in any other way. Thin sheets, from .005-01 of an inch in thickness, may be laid on closely woven cotton fabric that has been brushed over with the solvent. Upon application of pressure, together with heat, the sheet of the substance is intimately united to the fabric. The result is a highly flexible water-proof fabric which can be crumpled up in the hand without acquiring any set and without breaking the coating. In addition to its superior flexibility, the composition is more durable than those whose flexibility is due to castor oil, and, with tricresylphosphate present in proportions of 300 to 100 of nitrocellulose, is practically non-flammable.

Buttermilk in Form of a Soluble Powder

Irving S. Merrell, of Merrell-Soule Co., Syracuse, N. Y., relates that notwithstanding all his experimentation to produce concentrated buttermilk he has never been able to obtain a product in which there was not, either during the condensation or immediately thereafter, a separation of certain constituents, resulting first in a flaky appearance in the product and in a short time in a complete "wheying off," or separation of the coagulated proteids from the whey. The concentration of the buttermilk was accompanied by such increase of acidity as to render the proteids insoluble in the resultant product. Mr. Merrill also has devoted much effort to the production of a soluble buttermilk powder, both by the use of the hot, roll process and by the spraying process as devised by Stauf. It is found that the drying of buttermilk, and even ordinary fresh milk, upon heated rolls, destroys the solubility of the product.

Stauf's process comprises the introduction of milk in the form of a fine spray or mist into moisture-absorbing air, and does not affect the solubility of powder produced from ordinary raw milk. However, attempts to apply the Stauf process to buttermilk disclose the fact that the proteids of the milk are rendered insoluble during the drying operation, so that buttermilk reconstituted from buttermilk powder made in accordance with Stauf, which is the only known method of producing a soluble milk powder, shows within 30 minutes distinct evidences of separation, or "wheying off."

The commercial procedure of milk condensation which Mr. Merrell found unsuccessful in the concentration of buttermilk, is carried on by batches, i. e., a quantity of milk is forced into the vacuum pan, is replenished as the operation continues, and is allowed to remain there subjected to the heat for two or three hours, and is then drawn off and a second batch placed in the pan and boiled down in the same manner. Cool entering milk is continuously being mixed, and its temperature averaged with the heated concentrated milk in the pan. These conditions not only injuriously affect the flavor and keeping qualities of all milk, but have, in practice, been found unsuccessful in operating upon buttermilk, doubtless by reason of the increase in the acid content, whereby the proteids are rendered insoluble and separate or "whey off" in the product.

Mr. Merrell, U. S. Pat. 1,430,312, has devised a continuous process which involves a centrifugally produced, flowing layer of milk moving over a heated surface, in a vacuum of 23-26 in. of mercury, corresponding to buttermilk vaporizing temperatures of 144-120° F. The centrifugal force constantly tends to arrange the heavier portions of the liquid against the hot wall, but the heat lightens the liquid by producing vapor in it, and thus compels it to retreat from the wall to make place for the nonvaporized heavier portion, thus constantly arranging the light vapor-containing liquid nearer the center of the chamber where its vapor may escape most readily, and constantly arranging the non-vaporized liquid nearest the heated surface where it receives the greatest heat. By reason of this action, the material in contact with the heated surface is liquid until the instant of its displacement from contact with such surface. The moment it boils, it is immediately displaced by the heavier non-boiling liquid and moved inwardly, and the vapor, separated from the liquid by the centrifugal action, is discharged, while the liquid containing the solids is thrown back into the moving layer of milk. This automatic action of the contrifugal force constantly moving the cooler portions of the liquid into contact with the heated wall and constantly withdrawing the boiling portion with its bubbles, eliminates scorching of the material which occurs when bubbles remain in contact with the heating surface.

During its passage through the concentration chamber, which contains the centrifugal beater, the layer of milk is held in contact with the heated surface and is uniformly subjected to the heat, whereby the evaporation and condensation are uniform and are effected in the short time consumed by the passage of the milk through the chamber, approximately [illegible] minutes, and [illegible] to condense the milk [illegible] to 1 [illegible] is reduced to a minimum the change in the constituents. When the mechanically formed flowing layer of milk reaches the vaporizing temperature, it is not cooled by, or its temperature averaged with a considerable [illegible] body or wall at different temperature as in the "batch" process. With buttermilk concentrated as described and reduced to powder in the usual manner, the resultant product is readily soluble. The reconstituted buttermilk will not "whey off" for 48 hours, whereas fresh buttermilk will [illegible] within [illegible] hours.

Phenol Condensation Products in Motor Brake Linings

A great variety of friction compounds have been proposed [illegible] used either alone or in admixture, as asphalt, pitch, tar, gums, rosin, resins, wax, drying and oxidized oils, varnishes, sugar, etc., each of which has its defects. Brake linings impregnated with such compounds are softened by the heat developed by friction and cause annoying jerking when used in the brakes of vehicles. They carbonize at a very low temperature, losing their power or resistance, and often the linings will rip off of the brake bands. Oil and water are absorbed in varying degrees, permitting slipping, or in cold weather they may freeze on the brake drums. Heretofore is has not been possible to use condensation products of phenol and formaldehyde in the liquid state for impregnating purposes with any degree of satisfaction, as the liquid products are all too thick and viscous to penetrate and impregnate thoroughly the object to be treated. While it is possible to make this liquid thinner by solution, it has been necessary to use so much solvent that the concentration of the solution is so low that the finished object will be of inferior strength and quality.

William Achtmeyer, Middletown, Conn., who has devoted much study to the development of a satisfactory impregnating agent for motor brake linings, finds the answer in phenol condensation products prepared as set forth in U. S. Pats. 1,429,265-7. The combination of phenol and methylene-diphenyl-diamine. $CH_2(NHC_6H_5)_2$, he finds will yield a non-flammable friction product which will not soften under the highest heat of use, and is unaffected by water or oil. Brake parts made of asbestos, which is either compounded or impregnated with this product, will withstand temperatures up to 500° C., or higher, without being injured.

In the preparation of this product, Mr. Achtmeyer proceeds as follows: 400 parts phenol and 75-100 parts methylene-diphenyl-diamine (by weight) are heated in an open steam-jacketed kettle with agitator until ebullition begins. On completion of the reaction the water, 5-6%, formed thereby is expelled by further heating with agitation. The product while hot is a thin fluid of brownish color, of peculiar rancid odor, and of a more fatty consistency than characterizes the well-known phenolic condensation products. This product will not go over into the insoluble or infusible state at any temperature, but when mixed with 7-10% of paraformaldehyde or trioxy methylene the compound formed changes, on exposure to a high temperature, to a very hard, infusible and insoluble product. Previous to conversion by heat, it is soluble in acetone, alcohols and hot benzol. The combination in a single step is effected as follows: 100 parts phenol dissolved in 20-25 parts 40 per cent. formaldehyde solution and 75-100 parts methylene-diphenyl-diamine are heated to brisk ebullition in a closed, steam-jacketed vessel with agitator and reflux condenser. On completion of reaction heating is continued until the odor of formaldehyde disappears, when the product is discharged into an open vessel to cool and to separate the reaction water amounting to 15-20%. Last traces of water are expelled by heating to 90-100° C in the open vessel, with agitation. Continuous heating at higher temperatures converts the product into a hard insoluble mass. At the temperature of the process the product is a thin fluid readily impregnating fabrics, but it may be thinned down with amyl acetate or amyl alcohol.

After impregnation and separation of the solvent the material is heated in a suitable oven up to 100° C, when the temperature is increased slowly up to 150° C, at which the material becomes insoluble and infusible. Brake linings or shoes impregnated with this friction compound and hardened in this manner will not become soft, sticky, glossy or slippery when hot, or when wet with water or oil. They will effect smooth non-jerking braking action, and will exert a high degree of friction and will cause any moving body, no matter what the speed, to come smoothly to a stop in a very short time. Whether asbestos fabric is impregnated with this material or a composition is formed with asbestos as an ingredient, they change under the action of heat under ordinary pressure into a very dense and compact product, which will withstand higher temperature without injury better than any other brake lining treated with condensation product or other compound.

E. I. du Pont de Nemours & Co., Wilmington, Del., is arranging for the resumption of production at its Ashburn Works near Hannibal, Mo., used for high explosives. The mill has been closed for about a year past.

Personal Items

M. G. Donk, chemist on the staff of the Chemical Warfare Service, Edgewood Arsenal, has been appointed associate chemist, U. S. Tariff Commission.

* * *

Frank M. Jones, formerly of the research department, Brown & Co., Berlin, N. H., is now chief chemist, Durex Chemical Corp., Sweetwater, Tenn.

* * *

H. B. Merrill, professor of chemistry, Carroll College, Waukesha, Wis., is now research chemist, A. F. Gallun & Sons Co., tanners, Milwaukee, Wis.

* * *

Joseph Ebert, formerly with McKesson & Robbins, 90 Fulton St., New York, has engaged in the independent manufacture of special chemicals at Newark, N. J.

* * *

Ned D. Biddison, formerly purchasing agent, Natl. Aniline & Chemical Co., New York offices, is now on the sales staff, General Chemical Co., 40 Rector St., New York.

* * *

P. R. Croll, formerly assistant chief, research division, New Jersey Zinc Co., Palmerton, Pa., is now director research laboratory, Pittsburgh Plate Glass Co., Milwaukee, Wisc.

* * *

George H. Rhodes, formerly assistant, department of chemistry, Mass. Institute of Technology, is now on the chemical staff of Cheney Bros., South Manchester, Conn.

* * *

Frederick Stugard, formerly superintendent and chief chemist, Kosmos Portland Cement Co., Louisville, Ky., has been appointed chief chemist, Ragland, Ala., plant of the National Cement Co., Birmingham, Ala.

* * *

Dr. Frederick B. Power, Bureau of Chemistry, Washington, D. C., has been awarded the Flueckinger gold medal by the Swiss Society of Chemists for his work in the chemistry of alkaloids and essential oils.

* * *

W. J. Lawson, formerly in charge of the Newark, N. J., plant of the Sherwin-Williams Co., has been put in charge of sales and distribution of the recently organized pigment division of the Grasselli Chemical Co., Cleveland, Ohio.

* * *

F. B. Tough, graduate of the School of Mines, Columbia University, who has been supervisor of oil and gas operations on leased public lands, succeeds A. W. Ambrose now assistant director of the Bureau of Mines, as chief petroleum technologist of the Bureau.

* * *

N. W. H. Lenders, who was general manager of the Douglas Co. when the Cedar Rapids, Ia., plant was destroyed as the result of a starch explosion in 1919, has been elected vice-president, Penick & Ford, Ltd., which acquired the property, and general manager of the Cedar Rapids plant which has been rebuilt.

* * *

Harlan S. Miner, chief chemist, Welsbach Light Co., and Walter S. Landis, chief technologist, American Cyanamide Co., respectively '88 and '02 alumni of Lehigh University, Bethlehem, Pa., were among the distinguished graduates honored by Doctor degrees on the inauguration of Dr. Charles R. Richards, former dean of the College of Engineering, University of Illinois, as president on October 14.

Thomas Le Clear, formerly with the Uniform Color & Chemical Co., Perth Amboy, N. J., is now associated with H. B. Baldwin, chemist, Board of Health, Newark, N. J.

* *

L. F. Hoyt, M.I.T. '13, director, research laboratory, The Larkin Co., Buffalo, N. Y., addressed the chemical group of the Buffalo Chamber of Commerce on Nov. 6 on "The Function of Research Laboratories."

* * *

Dr. Chas. S. Venable, assistant director, Research Laboratory of Applied Chemistry, Mass. Institute of Technology, has been appointed director of research, Viscose Co., with headquarters at its Marcus Hook, Pa., plant.

* * *

Dr. M. C. Whitaker, vice-president in charge of operation, U. S. Industrial Alcohol Co., has been selected as the recipient of the Perkin medal which will be awarded at a meeting of the N. Y. Section, Society of Chemical Industry, on Jan. 12, 1923.

* * *

Elon H. Hooker, president, Hooker Electro-Chemical Co., and head of the American Defense Society, in an address before the National Civic Federation on Nov. 11, at New York, stated that America should stay out of the European sphere so far as it is humanly possible for us to do so.

* * *

Robert E. Swain, head, department of chemistry, Stanford University, has been appointed lecturer and recipient of the medal under the Charles Frederick Chandler Foundation of Columbia University. Dr. Swain's subject will be "Atmospheric Pollution by Industrial Wastes." The lecture will be in Havemeyer Hall, Columbia University, on January 9, 1923, at 8.15 P. M.

* * *

Curtis C. Meigs and W. B. Goentner, have severed their connection with Meigs, Bassett & Slaughter, Inc., chemical engineers, Finance Bldg., Philadelphia, Pa., of which they were respectively, president and assistant chief mechanical engineer, to organize with Hugo Schlatter, fromerly of the Hercules Powder, a consulting chemical engineering organization, with offices in the Girard Bldg., Philadelphia, Pa.

* *

To James A. Pugh, well known in Chicago and president of Eastman Springs Corp., Benton Harbor, Mich., manufacturers of carbonated beverages, is credited an appellation for the chemist, which is likely to become a classic. His chemist, Earl H. Cummins, enthused with the quality of his product, faked an order of 57 carloads, 160,000 cases, of ginger ale from the American Druggists' Syndicate of New York, which was shipped and stored at the Bush Terminal, Brooklyn, N. Y. After Mr. Pugh's investigation had disclosed the bogus character of the order, Cummins admitted that he never had received it. Mr. Pugh's description of his zealous production manager as "a great chemist, but a durned poor business man," has a reverse side in the statement that the latter has been sent to Ann Arbor, Mich., for observation in the Psychopathic Hospital. The weakness of the business management as well is disclosed in its failure to confirm this order before the investment in plant extension, etc., and "working like Trojans to get out that ginger ale."

Industrial Notes

Canadian Salt Co., Ltd., Windsor, Ont., has under construction a plant of 10-ton daily capacity for the liquefaction of chlorine, the first of its kind in Canada.

* * *

B. R. Armour, president American Aniline Products, Inc., and Heyden Chemical Co., New York, and associates have reorganized the American Vat Color Mfg. Co., 3223 South Western Ave., Chicago, Ill., with capital stock of 24,000 shares of no par value. Officers of the new company are: B. R. Armour, president; G. L. Armour, treasurer, and William Weskman, secretary.

* * *

Sinclair Consolidated Oil Corporation, 45 Nassau street, New York, will build an eastern refinery on a tract of 3,500-foot frontage on the Delaware River at Marcus Hook, Pa. Locations for thirty stills have been marked out. With the Sinclair pipe-line system extended to the Houston ship canal mid-continent crude can be brought to Marcus Hook economically by tank ships.

* * *

The International Lead Refining Co., a subsidiary of the Anaconda Copper Co., has completed the first unit of its zinc oxide plant at Akron, Ohio, and will start production on a large scale shortly. The plant is equipped with electric stills, which are said to be the latest equipment for the production of zinc oxide. It is expected that the local rubber industry will be the largest consumer of its product.

* * *

Pig-iron production in Utah, as an example of the co-ordination of the influence of freight rates and the utilization of local resources, will be watched with interest. The Columbia Steel Corporation, Salt Lake City, Utah, will erect on Utah Lake, forty-two miles south of Salt Lake City, a blast furnace of 500 tons daily capacity. Ample railroad connections, with extensive coal deposits eighty miles to the southeast and iron ore 200 miles to the southwest, provide the essential raw materials.

* * *

From a daily sale of twenty-five gallons to a present annual sale of over eighteen million gallons, aggregating in business $120,000,000, the growth of the Coco-Cola company illustrates what can be done with a chemical idea and a favorable environment. The company's annual sugar requirement is 320,000 barrels. The composition of this beverage is reported as 10.168% sugar, 0.015% caffein, 0.055% phosphoric acid, 0.005% citric acid, 0.348% caramel, 0.001% mineral matter and 89.410% water.

* * *

The Standard Development Co. is a recently organized subsidiary of the Standard Oil Co. of New Jersey, designed to handle the company's patent interests and for the investigation, acquisition and promotion or development of new processes and products related to the business of the Standard Oil Company and its subsidiaries. Frank A. Howard, head of the development department, whose work falls within the purview of the new company's activities, is president; G. W. McKnight and C. A. Straw, vice-presidents; H. M. McLaran, secretary, and Philip Berau, treasurer.

* * *

Pursuant upon the organization under the Webb Act of the Sulphur Export Association by the Union Sulphur Co., Texas Gulf Sulphur Co. and Freeport Sulphur Co. is the consolidation of the export storage and loading facilities of the three companies at Texas City and Galveston, Texas. The Union Sulphur Co.'s operations, heretofore confined to Sulphur, La., now embrace the development of a recently acquired deposit at Matagorda, Texas. The Sulphur Export Association will take full charge of selling in foreign markets. It is asserted that by this method price will be uniform at all times, although no attempt will be made to fix prices in the domestic markets.

* * *

Radium Co. of Colorado, Inc., 244 Madison Ave., New York, with headquarters at Denver, Colo., announces its consolidation with the Société Generale de Belgique which has a plant at Oolong, Belgium, for refining high-grade radium ores from the Belgian Congo, of a capacity surpassing all American plants. It is stated that this consolidation will mean cessation of all operations with carnotite ores of Colorado heretofore considered the richest in radium. Since July, members of the executive and technical staffs of the Radium Co. of Colorado, have been in Belgium in cooperation with officials of the Belgian company. The Radium Co. of Colorado will market the product in the United States.

* * *

Carbon black produced in 1920 is valued by the Census Bureau at $5,532,670, a 40.6-per cent. increase over the output of 1919. Of the 37 establishments reported in 1921, 2 are located in Kentucky, 13 in Louisiana, 1 each in Montana and Oklahoma, 18 in West Virginia and 2 in Wyoming.

Greater activity in carbon black production is being displayed in the Monroe, La., gas field than at any time since its discovery six years ago. Notable as the largest natural gas area in the world, it has been expanded by new borings to embrace over 300 sq. mi.

Compliance with conservation laws requires the extraction of gasoline from the gas wherever it can be profitably undertaken, which has encouraged drilling in sections where the gasoline content of the gas is highest. In the southeast corner of the field a large area yields gas containing 500 gals. of gasoline per million feet.

The Louisiana State Dept. of Conservation reports that carbon black plants operating in the field obtain from the gas sufficient gasoline to pay operating costs, making the carbon black clear profit. Production reached 32 million lbs. in 1921 and is expected to reach 40 million lbs. in 1922.

POSITIONS WANTED

Salesman, Graduate Chemist, B.Sc., age 27, desires position in a sales capacity in the chemical field. Has sales training and sales experience in another line. Box 1101, care Chemical Age.

Chemist, with two years' graduate work at Columbia University, having his Bachelor's and Master's degree, desires position with a firm where there is a chance for advancement. Box 1102, care Chemical Age.

FOR RENT

Four-story building about 10,000 square feet. Fully equipped for manufacture of edible oils. Equipment includes oil, hydraulic and filter presses, pressure and jacketed tanks, drying rooms, metal dryers, dry and fluid mixers, screens and evaporators. The Berg Co., Philadelphia, Pa.

CHEMICAL
AGE

A CONSOLIDATION of THE CHEMICAL ENGINEER and CHEMICAL AGE
LLOYD LAMBORN, *Editor*

VOLUME 30 NEW YORK, DECEMBER, 1922 NUMBER 12

The Executive and Research

By John A. Matthews

President, Crucible Steel Co. of America

THE popular conception of research, I am convinced, is a misconception. To the man in the street research suggests a laboratory and a genius of the high-brow type presiding over it. He is generally supposed to be a dreamer and probably impractical.*

Interest in the results of research as far as the public is concerned is apt to be centered in those that appeal to the imagination rather than to reason. The spectacular invention or discovery is what is expected by the public from a research laboratory.

Research Defined

The plain, literal meaning of the word "research"—to search again the facts, processes and phenomena of every-day life to find new relations, laws and results—is less often considered, and this phase is of less general interest to the public mind. The full definition of research is to search or examine with continued care; to examine into or inquire about diligently.

The field of research is not, therefore, limited to science; it embraces all branches of knowledge and human endeavor—of conduct, economics, history, civics and religion, as well as science and engineering.

JOHN A. MATTHEWS
President, Crucible Steel Co. of America

The Executive Function

The executive function has to do with executing, performing or carrying into effect laws, policies or orders of higher constituted authority. By definition the executive is not supposed to originate actions, but to carry out the wishes and instructions of others. This is not true today, even of the President of the United States, notwithstanding the specific functions laid down in the Constitution for the three branches of government—Executive, Legislative and Judicial.

It is not true in business either, for the modern executive of a great corporation must possess initiative, and is, in fact, more or less of a dictator of policies. His authority is so absolute that the function with which he is often connected is that of executioner—cutting off heads of subordinates. That is a mistaken view, frequently born of unhappy experiences, and it should be remembered that every executive desires most strongly to build up and not destroy. Even though he may be a dictator in a certain sense he is held accountable for his acts by the stockholders and their chosen representatives, the directors. The executive is, in fact, between an upper and nether millstone — the avaricious stockholders and the more avaricious employes — the one demanding more profits and lower costs, and the other more money and less production. How else can a man in that position satisfy every one without the aid of research; not research of the narrower sort from a special laboratory and special group of men, but research in its broadest aspect as affecting every operation, process and product, participated in by technicians, foremen and superintendents and, not infrequently, by alert workmen?

The Purpose of Research

In an address to the engineering division of the National Research Council, about a year ago, I said that commercial research has for its principal purpose the increasing of profits. That is what manufacturing concerns are operated for, and all departments of the organization must be co-ordinated so as to lead to profitable operation. Without this failure is inevitable.

---

*A paper presented at the annual convention of the American Society for Steel Treating, Detroit, Mich., Oct. [illegible], 1922.

Legitimate manufacturing profits are the reward the public pays for services rendered or risk taken. The desire for profits is the impelling motive that leads investors to take risks and build up industries that give employment to others.

The research department of a company may function in many ways to contribute its part to this success:

I. It may endeavor to improve the product, which leads to greater demand, larger output, greater ability to meet competition, and the ability to command higher prices.

II. It may direct its efforts toward lowering costs (1) by finding cheaper but satisfactory raw materials; (2) by improving old processes to increase yield or decrease labor, or both; (3) by developing new products and finding uses for by-products; (4) by finding new uses for existing products; (5) by improving operating conditions in the plant not directly connected with the product itself, such as effecting savings in water, fuel, lubrication and electricity, and by improving the working cycles, material movements and power conditions.

All of these result in public good and bring their reward because they lead to better goods, cheaper goods, or the better supplying of the public needs.

Spirit and Method of Research

Research in this broader sense, as well as in the restricted sense of the pure scientist, must be actuated by the spirit of a search after truth. The fact that the research is for a specific purpose—profits—must not be allowed to interfere with the spirit and method that should control all research efforts, whether the object is truth for truth's sake, or truth for profit's sake.

It is improbable that commercial research can adopt co-operative methods in peace times to the extent that is possible in pure science efforts, where the competitive factor is lacking. There are exceptions to this, however, as is evidenced by such splendid examples of co-operation as in the study of the fatigue of metals, of rock-drill steels, the gauge steel researches, in all of which I have had the privilege of participating along with other steel men.

There will exist a natural bond of sympathy and understanding between the executive and the research worker when each recognizes that his conclusions, to be valid, must be arrived at by the same method—the scientific method, whereby sound judgments are the result of a logical weighing of facts and events, their sequence and relationship.

Each will better understand the other if he will ponder the words of Dr. Karl Pearson, quoted from his introduction to the "Grammar of Science." I can do no better than leave with you his words of wisdom upon the meaning, purposes and scope of science and the development of the scientific frame of mind.

"The classification of facts and the formation of absolute judgments upon the basis of this classification—judgments independent of the idiosyncrasies of the individual mind—essentially sum up the aim and method of modern science. The scientific man has above all things to strive at self-elimination in his judgments, to provide an argument which is as true for each individual mind as for his own.

"The classification of facts, the recognition of their sequence and relative significance, is the function of science, and the habit of forming a judgment upon these facts unbiased by personal feeling is characteristic of what may be termed the scientific frame of mind. The scientific method of examining facts is not peculiar to one class of phenomena and to one class of workers; it is applicable to social as well as to physical problems, and we must carefully guard ourselves against supposing that the scientific frame of mind is a peculiarity of the professional scientist.

"*Science,* indeed, often teaches us facts of primary importance for practical life; yet not on this account, but because it leads us to classifications and systems independent of the individual thinker, to sequences and laws admitting of no playroom for individual fancy, must we rate the training of science and its social value higher than those of philology and philosophy. The first aim of any genuine work of science, however popular, ought to be the presentation of such a classification of facts that the reader's mind is irresistibly led to acknowledge a logical sequence—a law which appeals to the reason before it captivates the imagination.

"Let us be quite sure that whenever we come across a conclusion in a scientific work which does not flow from the classification of facts, or which is not directly stated by the author to be an assumption, then we are dealing with bad science. Good science will always be intelligible to the logically trained mind if that mind can read and translate the language in which science is written. The scientific method is the method of all logically trained minds. I believe more will be achieved by placing instruction in pure science within the reach of all our citizens than by any number of polytechnics devoting themselves to technical education which does not rise above the level of manual instruction.

"The field of science is unlimited; its material is endless; every group of natural phenomena, every phase of social life, every stage of past or present development is material for science. The unity of all science consists alone in its method, not in its material. The man who classifies facts of any kind whatever, who sees their mutual relation and describes their sequences, is applying the scientific method and is a man of science. It is not the facts themselves which form science, but the method in which they are dealt with.

Every great advance of science opens our eyes to facts which we had failed before to observe, and makes new demands on our powers of interpretation. This extension of material of science into regions where our greatgrandfathers could see nothing at all, or where they would have declared human knowledge impossible, is one of the most remarkable features of human progress. Great as the advance of scientific knowledge has been it has not been greater than the growth of material to be dealt with. The goal of science is clear—it is nothing short of the complete interpretation of the universe. But the goal is an ideal one—it marks the direction in which we move and but never a stage we shall actually reach. The universe grows ever larger as we learn to understand more of our corner of it."

Producers and Refiners Corp. has built a carbon black plant at Riverton, Wyo., the first unit of which is now in operation. Each unit will consume each 24 hrs. 5,000,000 cu. ft. of gas, yielding 100 bbls. of carbon black. The gas is drawn from a field 20 miles distant so the enterprise does not conflict with the terms of the Wyoming carbon black law, which prohibits the use of gas produced within 10 miles of an incorporated town which might furnish an industrial market for gas.

The Place of "Cracking" in Chemical Technology

Development of the "Cracking" Process and Its Present Status from the Patent Standpoint

By Frank A. Howard
President, Standard Development Co.

As used in the petroleum industry, the term "cracking" signifies generally the conversion by decomposition of a heavy or viscous oil of high boiling point into a lighter, free-flowing oil of lower boiling point. Specifically, the term "cracking" at the present time is almost universally applied to that particular species of decomposition by which gas oil or fuel oil is converted to yield a substantial percentage of gasoline.*

Historically Considered

Historically, the art of cracking goes back approximately one hundred years at least. This, of course, not in the modern petroleum industry, which has not had that length of life, but in the allied gas and coal-distillation industries. Animal and vegetable oils, waxes, fats, and resins appear to have been subjected to an operation which we should today call "cracking," in the very earliest days of the gas industry, for the purpose primarily of converting them into illuminating and fuel gas.

Almost as early, various natural bituminous substances, such as coal, shale, lignites, and more rare mineral deposits, which came very near to being solidified petroleum oil, were subjected to destructive distillation, both for gas production and for the production of light oil distillates. The earliest general use of this method of destructive distillation for the purpose of causing decomposition of complex bitumens into lighter oils appears to have taken place in connection with the shale and coal oil industry in England, where "cracking" processes of this description were very early utilized to increase the yield of refined oil, or kerosene.

Cracking for this purpose became a standard operation in the petroleum industry soon after it got on its feet commercially in America, and the process was highly developed in American refineries. By the aid of this method, the supply of refined oil, which was at that time the petroleum product in greatest demand, was very greatly increased. In the case of many crude oils the yield of kerosene obtained by cracking equalled the yield of natural kerosene so that in effect the kerosene production was in these instances actually doubled by cracking.

Burton Process

In the early years of the present century, when the demand for gasoline began to outstrip the demand for kerosene, it was natural that the oil refiner should turn to his prior cracking processes for inspiration and help in solving the new problem. The earliest process for cracking to produce gasoline which proved successful on a large commercial scale was that developed by Dr. William M. Burton and his associates, of the Standard Oil Co., of Indiana. This process was a pressure distillation method, the details of which were worked out so successfully by Dr. Burton and his associates that within two or three years there were several hundred stills operating according to the method in use, not only by the Indiana company, but by a large number of licensees as well located in all parts of the United States. The success of the process and its widespread use may be attributed not only to its intrinsic merit, but also to the circumstance that its details were worked out in such a manner that it fitted into existing refinery processes and organizations so perfectly, requiring the minimum of special knowledge, either in construction or operation, and the minimum change in the accepted refinery practices aside from the pressure distillation itself.

Inventive Rivalry

The Burton process, of course, was not the only one which came forward at this time, for the subject of increased gasoline supply was one of great importance to the whole industry, and refiners, as well as chemists, engineers, and outside inventors and scientists of all descriptions, were diligently at work on other processes. The historical background of the cracking art, involving as it did not only petroleum refining but the earlier industries of gas manufacture and coal and shale distillation, gave a fertile field in which inventors seeking to improve cracking for the production of gasoline could operate. It will be remembered that the Federal Government itself became interested in this matter, through the Bureau of Mines, and that much publicity was given to a process known as the "Rittman Process," the initial work on which was done under the auspices of the Bureau of Mines.

It was unfortunately a fact that in many instances, perhaps the majority of instances, the inventors and promoters of the numerous cracking processes which began to clamor for public attention and financial backing, very soon after the Burton process became generally established, either were unfamiliar with or failed to point out the historical background of the problem. It was believed by most persons not familiar with the details of the industry that cracking was an entirely new phenomenon and method; that the Burton process was the only known means of accomplishing this; and that anyone who was able to produce gasoline by cracking in a manner different from that of the Burton patents would be assured of a fortune.

The True Situation

The facts of the matter were quite different, i.e., cracking was not essentially new, nor was it by any means true that the Burton process was the only method by which gasoline could be obtained from heavier oils. Almost any one of the hundreds of prior cracking processes which had grown up in the three related industries of petroleum, gas, and coal, were available, sometimes without change at all and sometimes with only the very simplest changes, for the production of gasoline from heavy oils. Like every other practical proposition, it was a question of the dollars-and-cents results which was the final criterion.

For one reason or other, almost none of these competitive processes could be actually used on any large scale by the average petroleum refiner with any profit to himself. Either the gasoline yield was too small, or the quality bad, or the losses too high, or the processing costs excessive, or the equipment too dangerous or too costly, or some other single disadvantage or combination of disadvantages worked to outlaw the process from the practical refinery. At least half a dozen sizable fortunes have been sunk in efforts to convince the refining interests of the country of the practical value of the more energetically promoted of these processes. Much that was of real merit was involved in many of the processes, and some of them actually gained a precarious foothold in the industry.

---

*The Lamp, Oct., 1922. The Standard Development Co. is the recent incorporation of the development department of the Standard Oil Co. of N. J., as a subsidiary to handle the company's patent interests and problems relating to scientific, technical and commercial research in the fields of the company's activities.—Editor.

Nature of a Patent

It was inevitable that a development of this kind, involving such a large industry, and of such great importance financially, should become the subject of a host of patents. Several hundred patents have been issued dealing with cracking processes in the last ten years. The lack of any general knowledge on the part of the public as to the nature of a patent right is in large part responsible for the confusion which has existed with respect to cracking patents and with respect to their speculative or investment value.

It should be understood that a patent is not the grant of a right by the Federal Government to practice a certain invention, make a certain machine or use a certain process. Every person has an inherent right to engage in any lawful business, and this right is neither extended nor limited by the grant of a patent to him for an invention which he proposes to use. The right which the grant of a patent does establish is not the right to practice the patented invention, but solely the right to *prevent others from practicing the specific novel point of the invention.*

Elements of Invention

It is almost universally the case that an invention consists of a combination of something that is new with something that is old. In the art of cracking oil, the patents, without exception so far as we know, do not even purport to cover fundamentally the operation known as "cracking." They obviously could not do so, for this operation, under the same or another name, is at least one hundred years old. What the patents do cover, each of them, is some particular combination of steps, or pieces of equipment arranged for use in some definite fashion. Perhaps no single one of the pieces of equipment or the steps of procedure will be new in itself; perhaps the novelty will consist only in its application in that particular combination.

In other cases, the novelty may consist in the addition of some single new step or piece of equipment to an apparatus or process which was *in toto* old with the exception of that new part. For example, in the cracking art, probably two-thirds of the patents which have been issued relate to improvements in the same general method used in the Burton process, i.e., distillation of the heavy oil under pressure.

These improvements take all forms; they deal with the temperatures and pressures at which the distillation takes place, the form of the equipment used, the treating of the resulting products, and every imaginable variant. The Burton patents themselves, although generally regarded as the pioneer patents in this field of gasoline production by pressure distillation, do not purport to cover the mere act of pressure distillation to produce gasoline, but are limited to this process as carried out in a particular fashion which, in the judgment of the Patent Office, was new with Burton and his associates.

Infringement in the Field General

It follows from the above that almost all of the patented cracking methods, which have formed the subject of the large number of patents issued within the last few years, are themselves infringements of some one or more other patents, depending upon the basis upon which the inventor started to work. This fact, which is an inherent result of the nature of our patent system, has led to much misunderstanding and bitterness. Persons have invested large sums of money in the development of cracking methods only to discover what they could have found out by a five minutes' talk with a patent attorney in the first instance, i.e., that the method could not be used without securing licenses from perhaps one and perhaps a dozen earlier patentees whose separate inventions were involved in the particular method which they were endeavoring to commercialize.

Inadequacy of Patent Office Administration

A situation of this kind naturally becomes the more complex in proportion to the number of patents which are co-existing in the same field at any particular time. The importance of the cracking art naturally attracted inventors to such a great extent that there is perhaps no single patent situation which is more confused than this one. The situation has been made even worse by reason of the fact that the Patent Office has been laboring under difficulties in the way of inadequate funds and an inadequate staff during the past five years, resulting not only in the grant of some patents the validity of which may be seriously questioned but also in the almost indefinite holding up of applications for patent.

Since an inventor has a right to rely upon his application date as his effective date for most legal purposes, and since applications for patent, according to the rules of the Patent Office, are kept secret until they issue, it follows that even though a worker or inventor has developed a method which is free of infringement of any existing patent, he must still face the risk of the issue of a patent on a long-delayed application antedating his own and which will cover his own method.

Just this fate has several times overtaken the Burton process, i.e., patents issuing several years after the Burton patent was issued, and purporting to cover various phases of the process which had been worked out by the Indiana company and its licensees and employed on a large scale, totally without knowledge, or means of knowledge, of the existence of the other inventors. The Dubbs suit in which the Standard Co. of Indiana is now involved is the result of the issue of one such delayed patent.

Current Developments and Patent Litigation

The Standard Oil Co. of New Jersey has been a licensee under the Burton patents and has operated large numbers of Burton stills for many years. It has during that period devoted considerable time and money to research and experiments on cracking, and, as a result of this work, has been able to greatly improve the efficiency of operation of its Burton equipment. A further and more important result of the same work, however, has been the development of a process, known as the "Tube-and-Tank" process, which is just now going into extensive use in the refineries of the company. Based on the experience with it up to the present time, it is believed that this method will be in many respects superior to the Burton method, and since it does not infringe the Burton patents, nor, so far as can be determined, any other existing patents, the company is relieved from the payment of license fees in its operations under the new process. The company's patent position on the "Tube-and-Tank" process is in part the result of its own work and in part the result of its acquisition of the Carleton Ellis patents, which date back to 1914, thus affording some degree of security against future difficulties arising from the issue of delayed applications of others which may have been held in the Patent Office for many years.

There has been promoted recently, under the name of the "Cross" process, a cracking method which resembles that developed by this company, and which is believed to infringe the Ellis patents. Suit has been brought against the Pure Oil Co. of Ohio under the Ellis patents for the operation of this Cross process.

It is not the intention of the company to attempt to monopolize the "Tube-and-Tank" cracking method, but, on the contrary, a liberal licensing policy has been adopted with respect to this process. The Beacon Oil Co., of Boston, Mass., took such a license some time ago, and is in operation under it at the present time. The royalty rate fixed for the use of the process is ten cents per forty-two-gallon barrel of heavy oil cracked. Licenses will be granted to any reputable company on these terms.

Manufacture of Hydrogen Sulphide

By Henry Howard

The Grasselli Chemical Co.; President, American Institute of Chemical Engineers

THE ordinary commercial method of generating hydrogen sulphide is by the treatment of iron sulphide with sulfuric acid. This process is satisfactory for the production of small quantities of hydrogen sulphide, for instance, for use in chemical laboratories, and in the de-arsenication of sulfuric acid, but when considerable quantities of hydrogen sulphide are required the cost of the process is prohibitive.

It has been proposed according to the so-called Christensen process to treat complex sulphide ores containing zinc sulphide with sulfuric acid. A feature of this process is the use of a relatively large quantity of sulfuric acid, i.e., about 50 pounds of 52° Bé. sulfuric acid to one pound of ore. With this ratio of acid to ore and at high temperature the zinc sulfate formed is dissolved in the large excess of acid from which it is separated and recovered by cooling and crystallization. The use of a large volume of sulfuric acid is to enable the zinc sulfate to be brought into solution as it forms, the theory being that if it were not so dissolved it would form a coating over the ore and thereby prevent further reaction. The process is not a commercial success owing to the enormous volumes of sulfuric acid required and the expensive heat interchangers necessary for heating and cooling it.

I have devised a process* based on the theory that if the sulphide ore were ground sufficiently fine and then kept agitated in admixture with the acid, the reaction could be carried to substantial completion without dissolving the zinc sulfate formed in the reaction. I carry out the process as follows:

Sulfuric acid of about 52° Bé. is run into a lead-lined tank provided with a tight cover and efficient agitator. The acid is heated to about 190° C. and pulverized zinc sulphide ore is slowly fed in by means of an automatic and continuous feeding device, the contents of the tank being continuously stirred. The decomposition is almost instantaneous, producing a steady and continuous evolution of hydrogen sulphide, the flow of which is controlled by controlling the feed of ore.

As stated the ore must be finely ground. I have tried the use of ore that would all pass through a 200-mesh screen and have thereby obtained a yield of from 80 to 85 per cent of hydrogen sulphide calculated upon the sulfur content of the ore, while 97 per cent of the zinc sulphide content of the ore was converted into zinc sulfate. The loss of hydrogen sulphide has been found to be due largely to the formation of elementary sulfur. About five pounds of sulfuric acid are used for one pound of ore rich in sulphides. It is only necessary to use sufficient acid to cause the reaction to proceed to substantial completion and the amount of acid required for any particular ore may be easily determined.

After the requisite amount of ore has been fed in to a batch of acid the stirring is continued and the mixture boiled until evolution of hydrogen sulphide is complete, whereupon the stirrer is stopped and the batch cooled and allowed to settle. The supernatant acid, which is still about 52° Bé., is siphoned off and mixed with fresh acid and used again for the treatment of another batch of ore. The acid thus recovered and reused amounts to about one-half of the quantity used in each batch operation.

The slurry remaining in the bottom of the tank after the supernatant acid has been separated contains undissolved residue, zinc sulfate and free sulfuric acid. The sulfuric acid is separated on a sand filter and added to that siphoned off, for use in the next batch. The filter cake is then treated with water sufficient to dissolve the zinc sulfate; the solution is then neutralized by the addition of zinc oxide or zinc cinder. The zinc sulfate solution after separation from the undissolved residue, and purification in the ordinary manner, is available for use or sale as may be desired.

It will be seen that by my process hydrogen sulphide is cheaply and efficiently produced, in large quantities if desired, and that in the recovery of the zinc-content of the ore the cost of the customary roasting of the ore and the loss of zinc resulting from the formation of ferrites and silicates which are insoluble in acid are obviated.

Chemical Equipment Association

The Chemical Equipment Association has established national executive offices at 1328 Broadway, corner 34th street, New York City. Roberts Everett has been appointed secretary. The association has begun active work, through a national membership, for the fostering of trade in chemical equipment, and for the improvement of practices in the production and distribution of such equipment, and in the performing of engineering services incidental thereto. Not only does the activity of the association signalize the adoption of trade association methods by the companies constituting the equipment base of the chemical industry, but it represents a movement toward manufacturing and distributing co-operation in this field.

The association has already established communication with nearly two hundred of the large industrial associations of the country, announcing itself as a source of information in chemical equipment supply matters, and has begun a regular bulletin service to members. The association is, further, arranging details of a permanent co-operation with the Department of Commerce in the collection and dissemination of trade information.

* * *

In commemoration of the French chemist, Claude Louis Berthallet, his statue has been erected at his birthplace, Annecy, France, on the occasion of the centenary of his death, November 6, 1822.

---

*U. S. Patent No. 1,435,471, issued November 14, 1922.

Work of the Chemist in Portland Cement Manufacture

By J. C. Witt

Lewis Institute, Chicago

IN the modern Portland cement plant the laboratory is in many respects the most important department. Few users of the product realize the large number of chemical analyses and physical tests necessary in its manufacture. The physical appearance of cement gives no indication of its chemical nature. The fine gray powder looks as simple as gypsum or lime, yet gypsum consists of only one chemical compound, if we do not take into account the impurities present, and the same is true of lime. On the contrary, cement consists of a mixture of complex compounds.*

Lime may be considered the parent of Portland cement just as iron is the parent of steel. In both cases the parent makes up the greater part of the new product, but great changes in manufacture have been developed and other substances have been added. Our modern Portland cement was evolved from ordinary lime. At first the fattest or purest limes were considered best; then it was found that clayey limes had certain properties not possessed by fat limes. Then came natural cement and finally Portland cement, which is basically an improved natural cement; that is, instead of calcining rocks as they occur in nature, two or more materials are carefully analyzed and blended to give the desired composition before calcination. The composition of this mixture can be kept within narrow limits even when the composition of the raw materials fluctuates considerably. As a result we have the uniform dependable material known as Portland cement.

Laboratory Work

The work of the laboratory may be placed under the following heads: (1) Preliminary, (2) Control, (3) Miscellaneous. Although the procedure differs at various plants, it has many points in common. The work in connection with an average plant will be discussed.

In selecting raw materials for manufacturing cement, their chemical composition, physical properties and uniformity must be taken into consideration, consequently they must be sampled and analyzed. Usually the deposits are drilled at various points and samples obtained at different depths, so that the analyses reveal composition, uniformity and the amount of suitable material available. A number of trial burnings are then made and the resulting cement carefully studied.

Control

After a plant is in operation, tests must be made continually. In some plants it is necessary to make preliminary tests of the limestone before it leaves the quarry, but in others the stone is so uniform that this is not necessary. In any event, when the materials arrive at the plant they must be analyzed to obtain the values on which the proportioning is based. The raw mix must be analyzed before it reaches the kiln so that any necessary corrections can be made. Not only is the chemical composition of the raw mix important but it must be ground sufficiently fine and be thoroughly mixed, otherwise a uniform clinker will not be obtained. In the same way the chemical composition and the fineness of the coal must be watched. The fineness and the volatile content must be kept within certain limits and the ash and sulphur content should be accurately known. Before the clinker is ground a small percentage of gypsum is mixed with it and here again the operation is dependent on the analysis.

The finished product should be analyzed to see if it has the desired composition and should be subjected to the chemical and physical tests required in standard specifications. The accompanying table shows the minimum number of tests.

Miscellaneous

The work of the modern cement plant laboratory does not stop with the tests necessary for controlling the manufacture. In addition there are the determinations of the B. t. u. of the coal used in the power plant and in the kiln; occasional analysis of the ash from the boiler furnaces to determine whether or not the combustion is complete; analysis and draft measurements of the stack gases; analysis of boiler water and addition of treating compounds if necessary; analysis and temperature measurements of the kiln gases; physical and chemical examination of lubricating oils and greases; and many others.

Absence of Marketable By-Products

Cement manufacture differs from many other industries in that there are no marketable by-products and the entire effort of the personnel is confined to the one product. For a time the prospect of recovering potash from the kiln was bright but this is not at present an important consideration in the industry as a whole. The one big by-product is carbon dioxide. When we remember that approximately three-fourths of raw mix is calcium carbonte, that nearly one-half of this is carbon dioxide, we can realize that thousands of tons of this gas goes up the kiln stack, not taking into account the great amount produced by the coal. This carbon dioxide, no doubt, has a beneficial effect on vegetation, since it releases carbon that has been unavailable to plant growth for centuries.

Control Tests Necessary in Cement Manufacture

Raw Material, Intermediate or Finished Product.	Laboratory Operation.	Purpose.	Number of Tests.	
			Chemical	Physical
Calcareous material	Determination of Ca	Proportioning the raw mix	1	..
Clayey material	Determination of Ca	Proportioning the raw mix	1	..
Raw Mix	Determination of Si, Al, Ca (sometimes a complete analysis)	Checking chemical composition of the raw mix before it reaches the kiln	3	..
Raw mix	Fineness	Material must be fine for satisfactory kiln operation		1
Coal	Proximate analysis	Composition of coal must be within certain limits	4	..
Coal	Fineness	Material must be fine to insure complete combustion		1
Gypsum	Determination of SO_3	Proportioning clinker and gypsum	1	..
Cement	Determination of MgO, SO_3, loss on ignition and insoluble matter	Chemical requirements of specifications	4	.
Cement	Tensile strength (2 periods), setting time (2 periods), fineness, soundness, specific gravity	Physical requirements of specifications	..	7

---

*Cement, Mill and Quarry, Nov. 5, [illegible]

Chemical Education and Resources of West Virginia

By Friend E. Clarke

Head, Department of Chemistry, West Virginia University

WEST VIRGINIA UNIVERSITY, Morgantown, West Va., has had large increase in the student body in recent years. All buildings are crowded. Growth of high school attendance in the State points to a certainty that students will come in larger numbers in the future. All chemistry instruction is provided at one center on the campus, except certain technical courses in engineering, agricultural and medical chemistry which is given in the respective colleges of engineering, agriculture and medicine. Exclusive of students pursuing these technical courses, 744 students are doing regular work in chemistry during the current semester in the department of chemistry which occupies a building which formerly accommodated the departments of chemistry, physics, geology and a part of the work in engineering.

President Frank B. Trotter, members of the State Board of Education and the State Board of Control have seen the need of more room and better facilities for chemical instruction. Their recommendations were received favorably and a State appropriation of $400,000.00 was made toward a chemistry building, plans for which have been developed by the architects, Paul A. Davis, 3rd, & Dunlap, Phila., Pa., with the cooperation of members of the chemistry staff and officials of the University. It is expected that bids will be opened about January 1, 1923, and that construction will go forward soon thereafter.

FRIEND E. CLARKE

Head, Department of Chemistry, West Virginia University

The New Chemistry Building

The structure, shown by exterior perspective and floor plans in the accompanying illustrations, is essentially Georgian in architecture. It will be of four stories, basement and attic and covers with the basement and first floor 305x79 ft. The main portion of the building will be 254x79 ft. The largest lecture room, at the west end of the building, will seat over 300 and is entered from the campus on the basement level of the building or through the corridor of the first floor. Lighting will be entirely through the ceiling, there being no side windows. The lecture desk is 28 ft. in length, 10 ft. of which is stationary, with the usual service equipment, drawers, cupboards, etc., as is also the front part of the remainder, but the rear part will consist of a light frame work of structural steel placed on a track leading to the preparation room to permit rapid changes of equipment by the substitution of a duplicate section kept in readiness. This plan makes possible the use of the auditorium during consecutive hours of the morning or day.

The basement provides the general service of the building. Here are ample receiving and storage rooms with elevator connecting with distribution rooms on all floors, boiler room, refrigerating room, shop, three fan rooms, locker room, a small laboratory, constant temperature room, and a gasometer room where the gas will be put under greater pressure than that provided in the service mains. The basement fans will force fresh air throughout the entire building, the circulation to be through cement conduits arranged under the area ways on the outside of the building, from which the air will be discharged into the various rooms through recessed conduits in the walls. Fumes from hoods and certain desks in the general and qualitative laboratories will be exhausted by a series of special fans located in the attic. It will be possible for a student or a small group of students to get good ventilation at odd hours without running the entire ventilating system.

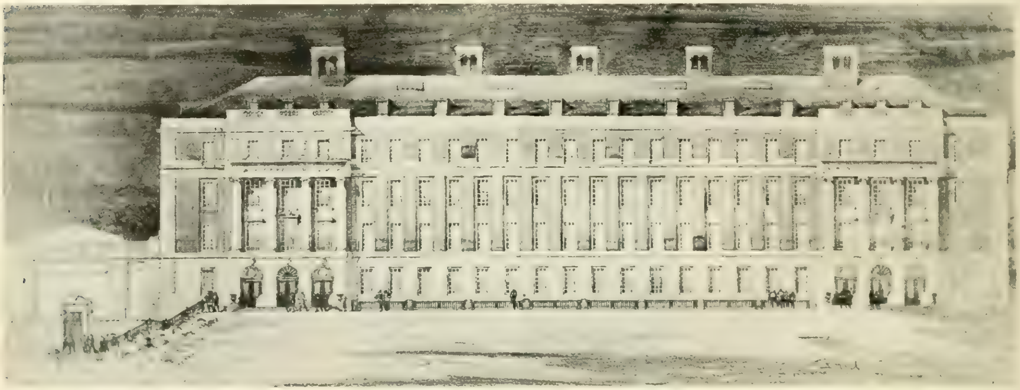
The first floor will accommodate the department of physical chemistry and a portion of general inorganic chemistry. A lecture room begins on this floor and extends through the second floor, thus throwing the height through two stories into the lecture room. Special storage rooms for research chemicals and apparatus have been provided on this floor. The second floor will be arranged for general chemistry, with certain unusual provision for the future. The laboratories at the front of the building will have all equipment except desks. Temporary partitions will be installed in order to supply a number of recitation rooms, possibly to other departments, until this section of the building is needed for laboratory purposes. The general distribution room for student supplies is on this floor.

The third floor is adapted to analytical chemistry, supplying special laboratories as indicated on the floor plan. The general offices of the department and the library are on this floor. The fourth floor will take care of the work in organic chemistry. There will be special laboratories for Kjeldahl digestions, for general combustion work and several private research laboratories for use in any branch of chemistry.

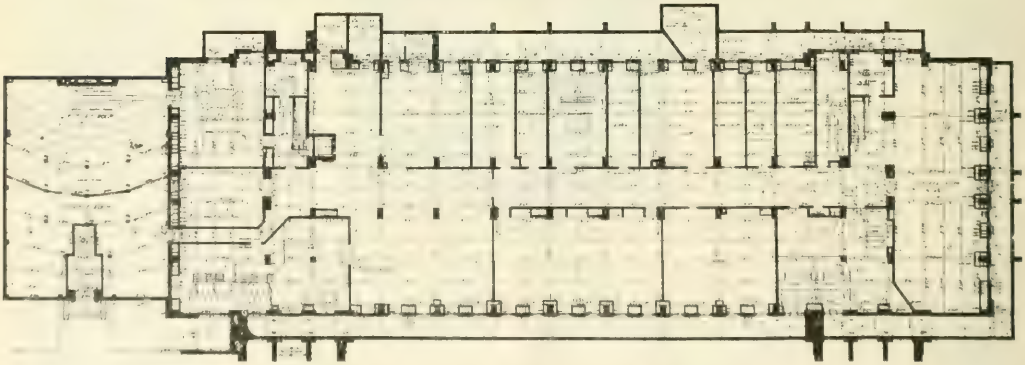
In the attic will be an assembly room for informal gatherings of chemistry majors, distilled water plant, hydrogen sulphide generator room, and two bed rooms for advanced students in charge of the building at night. In addition to space for the ventilating system, there will yet remain some space for future expansion of the department along certain lines. The top floor will be well lighted by skylights and dormer windows.

The building will be most useful to the State, not only through the adequate means that will be available for teaching chemistry to its youth, but also for aiding in projects which have for their object a broader development of the commonwealth's natural resources. Our natural resources are very great and at present much can be had for a relatively small amount of work. For example, a university professor while engaged in preparing some terraces in his garden, incidentally removed enough coal to last him several months during the winter. Another citizen, while drilling for water, struck natural gas at a depth only slightly beyond 100 feet. He invited his neighbors to hook up to his well and enjoy cheap fuel. Other similar wells were drilled with satisfactory results. In a large way our coal from numerous seams, and the by-products therefrom, our oil, gas, glass sand, limestone (we have greater acreage than Kentucky) are being developed and systematically marketed. The industries that utilize these natural resources will require the help of chemistry and the cooperation of chemists in ever-increasing numbers. We shall hope to be of service in supplying chemists for these positions.

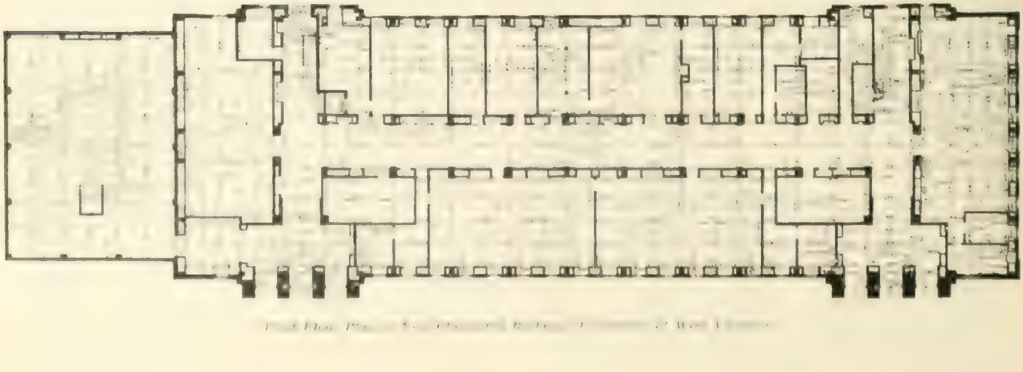
The present staff of chemists in the several colleges of the University number 14 of professorial rank. Of these 7 are associated with the writer. The faculty of the chemistry department itself is composed of 8 of professorial rank, together with instructors, graduate and undergraduate assistants, making a total of 21. In connection with the erection of this splendid structure for the Department of Chemistry at the University of West Virginia, some facts concerning the natural



Front View of the New Chemistry Building, University of West Virginia, Morgantown, West. Va.



[illegible] Plan of New Chemistry Building, University of West Virginia

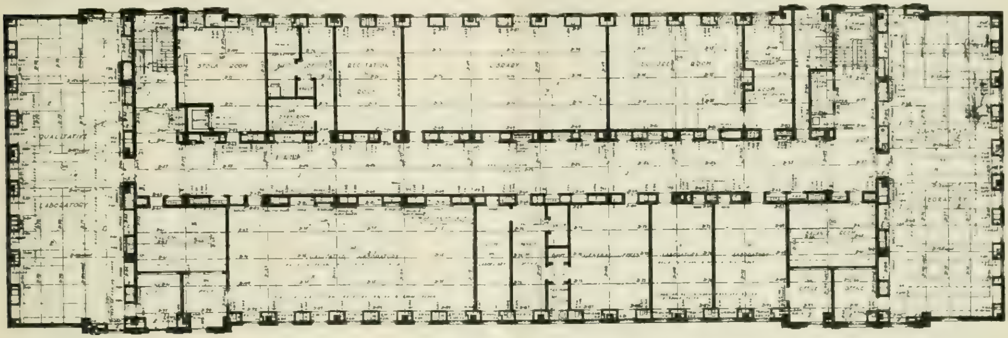


First Floor Plan of New Chemistry Building, University of West Virginia resources and progress of this commonwealth will be of general interest.

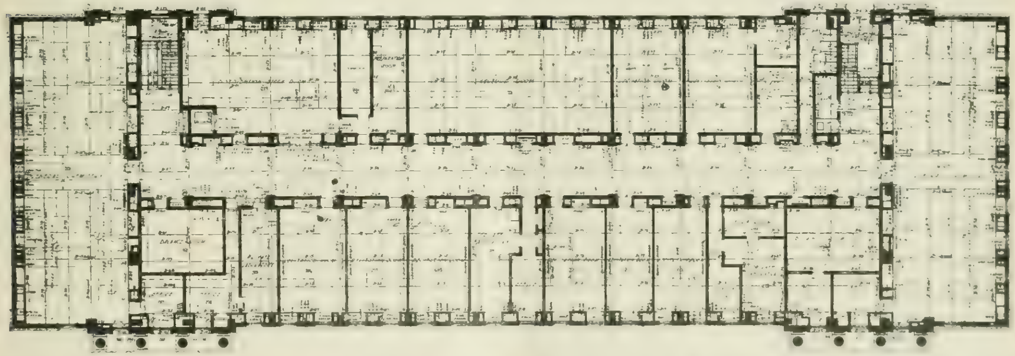
Resources of West Virginia

While West Virginia is not one of the large states in point of area, it is larger than the combined areas of Connecticut, Delaware, Massachusetts, New Jersey and two states the size of Rhode Island. The population, 1920, was 1,463,701, which is an increase over 1919 of 19.9 per cent. The native white population constitutes 89.86 per cent and foreign born, 4.23 per cent of the total population. The assessed value of real and personal property and public utilities was $1,696,068,361 in 1921. Based on the assessment valuation the total wealth per capita is $1,159. The 338 banks of the State care for an average of $250 per capita which sum represents an increase of 22.2 per cent in three years.

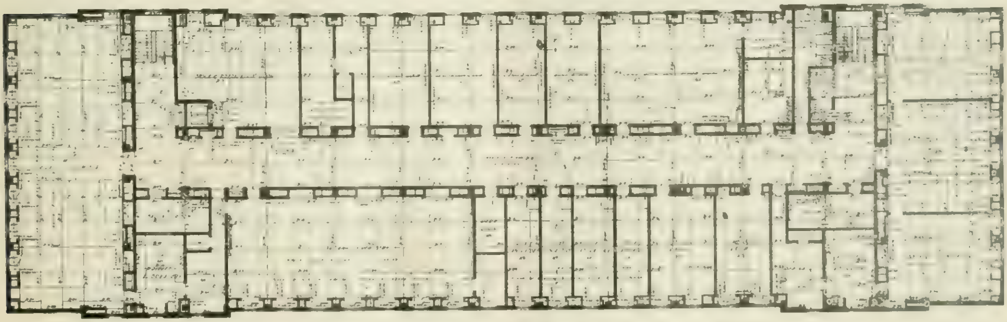
The economic development of West Virginia may be said to center around coal, oil and natural gas. During the years, 1859-1922, approximately 330,000,000 bbls. of oil were produced, with a value of $600,000,000. Authorities estimate a reserve of 200,000,000 bbls., assuming that oil is to be taken from the earth by present methods. The potential oil reserves are far greater than above figures. In the near future oil-bearing rock will be mined and subjected to steam distillation. What then will be West Virginia's produc-



Second Floor Plan of New Chemistry Building, University of West Virginia



Third Floor Plan of New Chemistry Building, University of West Virginia



Fourth Floor Plan of New Chemistry Building, University of West Virginia tion? The present annual production of oil in West Virginia is approximately 8,000,000 bbls., which represents about 2.4 per cent of the total production in the United States and about 1.58 per cent of the world's production. Of natural gas the State has produced 3,700,000,000 cu. ft. There remains an estimated reserve of 2,400,000,000 cu. ft. The present annual production is 250,000,000 cu. ft. which is 40 per cent of the total annual production in this country. The estimated total value of gas production to date is in excess of $650,000,000.

West Virginia has 2.72 per cent of the world's coal, with reserves estimated at 110,000,000,000 short tons. Her annual production is 16.97 per cent of the world's output. Within ten years the coal production has increased fifty per cent. There are about eighty coal seams in the State, of which probably forty are being worked. There are all varieties of bituminous coal. In the southwestern portion of the State there is a variety known as smokeless coal which is not anthracite; nevertheless, it is low in volatile matter and high in fixed carbon. The output of this coal, covering portions of six counties, is purchased almost exclusively by the Government. The old beehive coke-oven is not now being built in West Virginia. Slowly but surely the by-product plants are replacing them. Already there are two such plants.

West Virginia companies will continue to use their gas lines long after natural gas has ceased to be an important factor. Coal gas from the by-product plants will fill the mains to supply adjoining States with fuel. At present considerable quantities of coal are shipped to by-product plants in other States. The annual value of coal produced in West Virginia is $200,000,000. More than ninety thousand men are employed in the business, with salaries aggregating $106,000,000. The total capital invested is in excess of $344,000,000.

The world's first carbon black plant was located in 1872, and since that date West Virginia has kept in the lead. The annual production is about 30,000,000 lbs., which is 69 per cent of the production of the entire United States. The State has 27 plants and supplies two and one-half times as much carbon black as Louisiana, its nearest competitor. Casing-head gasoline production by the natural gas gasoline industry of the State is represented by 211 plants yielding 15.3 per cent of the country's output, valued in excess of $13,000,000.

There are great potential commercial possibilities in connection with the utilization of wood waste, particularly the products from hardwood. Many companies are producing large quantities of hardwood lumber without any reference to proper handling of the waste. Moreover, one company has acreage in reserve to run its mills for 25 years. One, therefore, can understand that the future may see wonderful developments in the wood-waste industry of the State.

The government munition plant at Nitro, W. Va., which was built during the war, has been preserved. The several units have been sold to private corporations and are being successfully developed.

The potential importance of West Virginia as an iron ore center is of importance. There are now more than 250,000,000 short tons of good ore available, awaiting the development of railroad facilities. It is a matter of history that many of the early charcoal iron ore furnaces were located within this State.

The inexhaustible supply of glass sand and of cheap fuel has brought West Virginia to the front of the ranks as a glass-producing State. She manufactures approximately two-fifths of the glass of the United States, and has some plants that are not duplicated in any part of the world. The same should be said also of her potteries. Foreign commissions frequently visit these plants for the purpose of studying methods and quantity production.

Brewing Industry's Hopes

Sentiment antagonistic to the Volstead act has been emboldened by recent political developments to the degree to direct attention to the present brewing capacity of the country. Brewing and distilling plants throughout the country following the enactment of the 18th Amendment underwent an adaptation to industrial uses of various kinds unrelated to their original purposes, with consequent deflation of values in many cases. Many brewers are making near-beer, some with occasional inadvertence to dealcoholize, otherwise where does the supply at 50 cents a bottle come from? Some make denatured alcohol, soft drinks of various brands and some malt syrup, but all these combined occupy only a small part of the vast capacity of breweries which once turned out trainloads of beer daily.

The preparedness of Jacob Ruppert, Inc., of New York City, to take advantage of a definition of an intoxicating liquor more titillating than the present discredited brew lends interest to the situation of the industry in Milwaukee. The Pabst Corporation in ten months of 1922 turned out 11,732 barrels of near-beer. Pre-war capacity of the plant in the same period was 1,200,000 barrels of real beer. The plant of the Schlitz Brewing Co., covering many square blocks, is idle. The genius of the Schlitz millions has gone into many other lines, notably into the new Eline chocolate and food plant, just outside of Milwaukee.

The Pabst brewery has been changed more than any other in the city. Brew houses are still intact, but other buildings have been converted into factories. No less than forty-six separate industries are now housed here, thousands of employes working in the hosiery factory, the motorcycle assembling plant, a large creamery, a shoe factory, a garage, a knitting plant, a welding concern, a box factory, and many others. The brew houses cannot be converted, and will have to be used for beer, if it comes back, or be torn down. Low rentals, free heat and other inducements had to be made to rent the buildings for other purposes.

Pre-Volstead values of Milwaukee brewing property have been estimated as follows: Schlitz Brewing Co., $14,000,000; Pabst Brewing Co., $12,000,000; Blatz Brewing Co., $7,500,000; Miller Brewing Co., $3,500,000; Cream City Brewing Co., $1,500,000; Milwaukee-Waukesha Brewing Co., $1,500,000. Four smaller breweries were valued at $500,000-$850,000 each. These properties, the Wisconsin Brewers' Association has estimated, were worth approximately $50,000,000 before the war. One of the small breweries was sold recently for only $31,000. Some of the small breweries have been dismantled. Several of the plants, however, could make large quantities of real beer on short order.

As regards the restoration of light beer and wines, and the resulting rehabilitation of the brewing industry in the United States, the wish is father to the thought of their proponents more than it is based upon the actual situation. The 18th Amendment, now a permanent part of our fundamental law, prohibits the manufacture and sale of intoxicating liquor. The adoption of any of the so-called light wine and beer proposals would be such contravention of this constitutional provision that there is no prospect whatever of the adoption of such legislation.

The Chemical Exposition

FROM many sources we have received commendation of the discussion in November CHEMICAL AGE, wherein we sought to set forth the character of the Chemical Exposition as a trade institution and to enable our readers to think clearly on the subject. We are convinced that the great majority of former exhibitors and the industry generally have faith in the efficacy of a chemical show to visualize industrial progress in chemistry and to serve as a market place for chemical business men and as a means of bringing in an impressive way to the American people the importance of chemistry to national welfare.

We are equally convinced that the Chemical Exposition cannot survive and realize its potentialities as a great educational agency as it has been conducted in the past. This conviction is confirmed by the report of the committee of the Chemical Salesmen's Association and by numerous letters from former exhibitors several of which are here reproduced.

Church Street, New York.

Editor, CHEMICAL AGE:

The more is said about the Chemical Exposition the less interest there is in it, if others feel about it the same as we do. You are not going to get prospective exhibitors enthusiastic about a Chemical Exposition, which to us is a Chemical Equipment Exposition, so long as it is run for private profit with no share in the management by exhibitors, but the real fact of the matter is the thing has gone stale. We write you this because we appreciate your intelligent discussion of the subject free from any personal interest which cannot be said of some publications.

November 24, 1922.

Jersey City, N. J.

Editor, CHEMICAL AGE:

In all this comment and questionnairing on the Chemical Show, your discussion has been the most effective in reflecting opinion in the industry. Let the International Exposition Co. give the chemical industry a rest. Then if we want an exposition we have trade organizations who can handle the business as often as the industry wants it. If your suggestions are followed out, the Chemical Exposition will be made a cooperative affair managed by representatives of exhibitors. Do you believe the International Exposition Co. will apply these suggestions?

November 27, 1922.

Broadway, New York.

Editor, CHEMICAL AGE:

Did you notice the discrepancy between the number of exhibitors who had signed up for space in the 1923 Chemical Show as reported by the Chemical Salesmen's Committee and the number given out by the International Exposition Co. about six weeks before as having contracted for space? The ratio of 34 to 131 is an index of the misrepresentation which has been handed out to prospective exhibitors to induce them to sign up. On top of this, is Dr. Herty's statement printed in your paper that "More exhibitors have signed contracts for the 1923 exposition than in any previous year at the corresponding date."

Number 13 is an important suggestion in your list for it would serve as a gauge to the interest in the industry in an exposition and compel the management to sell it on its merits and not on the compulsion that a man must be in because his competitor is, regardless of any benefit derived from exhibiting.

November 24, 1922.

Chicago, Ill.

Editor, CHEMICAL AGE:

We have read with much interest your editorials and article on the Chemical Exposition in CHEMICAL AGE for November and will say that they are the most illuminating discussion of this subject we have seen. The two main facts are: Those who want a Chemical Exposition every year are of the class who do not find it worth while to exhibit or have nothing to exhibit or who are satisfied to have someone else stand the cost of concentrating for a week an uncertain part of public attention on the chemical industry.

The other point is that chemical equipment makers have revolted against a system in which their chief part is to pay the excessive cost of running it without any voice whatever in its management. We, for one, are out of it until the whole affair is on a cooperative basis and free of the control of men intent more on what they can get out of it for themselves, than helping the industry.

December 1, 1922.

However embarrassing the disclosures and comment of the Chemical Exposition may be to all identified with the management and methods of the enterprise, the situation cannot be regarded as other than healthful for it represents the evolutionary process at work in the growth of this institution as an instrument of service. We cannot escape the comparison of Charles E. Hughes' investigation of 15 years ago of the life insurance business in New York, with the public spirit of Adriaan Nagelvoort in setting the exposition of American chemical industries in a direction whereby, on the one hand, it may meet the general good will and support of the industry, and, on the other, may fill out to its potentialities as an educational agency. Just as life insurance enriched the stockholders of life insurance companies before scrutiny of its business methods compelled mutualization of its benefits, so recent public education in matters appertaining to the exposition management has made clear the conditions precedent for its continued existence.

These conditions are: 1. Mutualization of the enterprise, whereby it will be conducted on a cooperative basis by representatives of exhibitors; and 2, such frequency of exhibition as industrial conditions may demand, instead of as professional showmen may elect.

The one outstanding lesson to chemical industry in its experience with professional showmen is the impolicy of cultivating an organization or permitting by acquiescence one to grow up which will resort to methods to induce action which good management would condemn if complete information were available. Commendation is due Mr. Nagelvoort for his temerity to initiate a movement for the benefit of chemical industry at a time when no patron of the International Exposition Co. had the courage openly to express an opinion through fear of reprisal. As the result of his work, the Chemical Exposition is in the hands of the industry, as is indicated in the discrediting of the present management by the replies to the Chemical Salesmen's questionnaire, which, notwithstanding its incomplete and variant character, can be interpreted in no other way.

Before our detailed discussion of what the Salesmen's committee submitted as reasonably within the accomplishment of a chemical industry exposition, let us consider briefly the finances of the Show, for here as elsewhere, it's money that makes the mare go. We should not withhold full faith and credit to the group which heretofore has been the main support of the show and without which the show as a business proposition will not persist.

The Chemical Equipment Association as an organization has taken no part in the discussion of this subject, apparently satisfied to remain silent until commentators and participants in the log-rolling come to the realization that no exposition, whatever its character or appellation, can succeed without this group. It is obvious to the discerning that the situation eventually will so shape itself that this group will dominate it, as it should by virtue of the strength of its position as the fundamental factor in chemical industry. However much the work of the Chemical Salesmen's committee in procuring from the industry confirmation of opinions bred of good judgment and common sense may be appreciated, activity of its members in flirting with the old management keen to "pick up" anybody that may aid in the perpetuation of its control, will be at a sacrifice of the solidarity of the exhibiting element of the industry which is easily possible of attainment if each group is satisfied to occupy the position indicated by its relative importance in the general scheme.

Doubtless the Chemical Equipment Association is satisfied with developments, for after the refusal of representation of equipment exhibitors in the practical management of the Exposition, which the importance of equipment manufacture warrants, it logically would welcome a situation where, in cordial cooperation with the other well-defined divisions of chemical enterprise, the entire body readily could build an organization that could command the confidence and support of all elements essential to the success of the exposition. We emphasize this aspect of the matter because of a conviction shared by many that management of the show by a single group, or its assumption of responsibility for the conduct of a subsidiary attraction financed by a percentage of the receipts from a show under the old management, never can effect that consolidation of enthusiasm indispensable to a creditable display of chemical industry.

As a result of all the talk, which, as one correspondent stated, is becoming tiresome, the one thing that stands out like a sore thumb is the certainty that future chemical expositions will be on a cooperative basis, under the directorship of representatives of classified exhibitors, with the satisfaction of every exhibitor that comes from knowledge of actual conditions of management to which he has contributed.

If sound organization that looked primarily to genuine service to chemical industry and hence to harmonious perpetuity of the Exposition had marked its history, instead of its use by the management as a means of making money out of exhibitors, there would be no discussion now about having it annually or biennially, or the futile effort of a group to make the tail wag the dog, for exhibitor control of the management would have developed ways to maintain its usefulness as a market place and to keep fresh technical and popular interest in the displays.

That the Chemical Exposition has not been more intelligently illustrative of chemical industry and how it serves the nation is not the result of the prominence of the chemical equipment division but of the lack of cooperation of chemical manufacturers, notably in 1922, and of the lack of interest of management that looked not beyond the sale of space. To reinspire the industry with enthusiasm for the recreation of this needed institution it must be mutualized and managed as the industry's enterprise, for which sound and workable plans already have been submitted to all exhibitors and to the industry generally.

Let us now consider the four fundamental objects submitted by the advisory committee as reasonably possible to accomplish by a Chemical Exposition.

I. Educate the American public to the basic importance of chemicals in modern life.

This is a job fraught with high futility and if it could be accomplished it would have no more effect on chemical industry than has the public's appreciation [illegible] value to the importance of [illegible] and profits of that industry. Popular education does not proceed [illegible] tangible from [illegible] fertile to suggestion which in turn [illegible] a measure of their interest.

To assume that the public can be taught about chemicals in a way to advantage chemical industry betrays a childish comprehension, not only of the educative process as it works in society, but of the economics of the industry. What the public can be taught is about commodities which it consumes directly and hence is in a position to judge as to quality and price. As a general proposition, the public does not consume chemicals; it consumes the products into whose manufacture chemicals enter, or to make which, as chemical products, a technical knowledge of chemistry is essential.

In restricting popular education in chemicals, as a purpose of the Exposition, to education in "the basic importance of chemicals in modern life," we pass from the concrete to the abstract, and so magnify the futility of the job. The public is learning as rapidly as reasonably can be expected from the efforts made about the importance of applied chemistry to national welfare.

Chemical and chemical engineering business men, however, who show their products at a Chemical Exposition and who spend money with the intention of its return in the growth of their business, do not want a market place for highly technical commodities cluttered up with curiosity seekers who have little if any more relation to their business than has the Esquimo to the manufacture of Palm Beach suits.

You cannot combine education in popular science in the contracted space of an industrial exhibition in the limited period of six days with satisfaction to business men whose excuse for their presence is the urge to make money, with a highly technical display of products to understand which requires technical education. The way to "educate the American public to the basic importance of chemicals in modern life," is the way we have outlined outstanding aspects of which are to subject it to the inconvenience or discomfort of deprivation of them, and to increase its convenience and comfort by providing it with new and useful products which are chemicals or into which chemicals enter.

II. Educate the industry to the new developments both in products and in apparatus.

This is what past shows have attempted, chiefly in apparatus, however, for reasons already set forth.

III. Serve as a market place both for chemicals and chemical apparatus.

This likewise is the object of an industrial exhibition.

IV. Furnish a common meeting place for the industry and its customers.

This is embraced by object No. III. We have emphasized hereinbefore the one essential thing that will contribute most to revivify the Chemical Show, viz., the mutualization of the enterprise and the inculcation of the spirit that this is the Industry's Show, Our Show—with its deficiencies and its glories, Our Show!—with the rivalry of every one to surpass his fellow to make the thing go. Objects II, III and IV will have a new birth under the promotion and guidance of well-known and well-liked men representing respectively the five grand divisions of Raw Materials, Equipment, Manufactured Products, Distribution and Education, which make up the Pentateuch of Applied Chemistry.

We have in the first four divisions ample field for the resourcefulness of capable men to find novelty of presentation, and in the fifth a heretofore neglected field which is the cornerstone of chemical enterprise. We do not have to resort to the lecture or the spectacular or borrow the plan of technical bodies to hold national meetings in New York to serve the doubtful double duty of an attraction and a [illegible] when we have in these divisions suitably managed and presented the heart and soul of the Chemical Show.

The Chemist and Chemical Control in Industry

An Appreciation of the Factory Chemist and a Recommendation of His Usefulness in Paper-Board Manufacture

By K. I. Herman
President, K. I. Herman Chemical Corporation

IN a paper mill or a paper board mill or any other line of industry that is using large quantities of raw material, if you don't know what you are buying you don't know whether you are making money or not. I should rather have said, instead of "chemical control," "technical information" on the thing you are doing. To get chemical control in a board mill is not a matter of having efficiency experts come in and tell you how to run it. It is a matter of engaging a chemical engineer, preferably a young man, right out of college. Put him under the direct employ of the superintendent and let the superintendent tell him what he wants, and let your chemist get that.*

I want to repeat one thought. After every great war there comes a great upheaval of the human mind which is exhibited in a great many ways. A general change in the method of living takes place. After the last great upheaval, fifty years ago, at the time of the Civil War and the Franco-Prussian War, the upheaval took a turn towards mechanical development, and the fifty years following those wars brought mechanical development to a state of perfection, so that today when anyone starts on the improvement of anything we think in terms of mechanics. The great war has caused such a tremendous upheaval that the patent office is overwhelmed with applications, and all the way through you will find the human mind intensely active. The result of this war is going to be the great development in chemistry. There are great forces working.

The paper or paper board mill or any manufacturing plant that does not get in line with the trend of the times is going to be left behind. That sounds hard, but it is not. The practical method of chemical control of your mill is this: In the board mill you have several items of which you make large purchase, as coal, pulp, paper stock of various kinds, straw, etc. When you buy 1,000 tons of pulp, and the records show a discrepancy in output, and the big chief comes out and says, "What are you doing with our pulp? You put too much pulp into the beaters."

You bought a pound of pulp and you never got it. You thought you did. You get a certain amount of water, you know that. You know how much water there is in it, but you don't know how much loading you had. I want to tell you you are buying a lot of it, and don't know it. Your chemical engineer with his little laboratory which only costs five or six hundred dollars to equip (you can equip a peach of a laboratory for a thousand dollars) samples every carload of pulp or coal or anything else you buy. It is his business to do this. He samples that and tells you that every ton of pulp you bought represents 922 pounds of available fiber, and that is all you need to know. If you have this much available fiber you are only going to get so much paper out of it.

The sampling of pulp as done by a chemist is different from when other people do it. He would go into the car before they start to unload it, take a sample from each of the four corners, and the middle. He would weigh it, put it away. As the car was unloaded he would take other samples, and put them away. Finally, he would take that whole bunch which might be ten or fifteen pounds of pulp, and grind it up into a mass and quarter it until he gets a small amount of pulp, maybe an ounce or two, that represents the shipment accurately. That takes a technical man; you haven't time to do that stuff. It takes patience and men trained to do it. When he is through he will take that piece of pulp and put it through his chemical and physical tests, and tell you that carload for which you paid for fifty tons of pulp has only forty tons of available pulp in it. You then can tell the president why it is you couldn't make more paper, because he didn't buy but so much pulp. This applies to the whole gamut of materials used in the paper mill.

Alum is supposed to contain 14-18 per cent of aluminum. One-sixth of your alum is aluminum and all the stuff you need in that alum is aluminum. The other five-sixths are of no use to you. If some manufacturer sells you alum that contains 12 or 13 per cent of aluminum, and you put so many pounds in your beater, you are going to get results and you don't know why. Your young chemist can tell you.

Most board mills get their water from wells. That well changes its complexion so often you would be surprised. One of the duties of your chemist is a quarterly or monthly analysis of the water coming out of that well. It may be running up very high in sulphates or solids, and you may be having all kinds of boiler trouble and the boss says, "It is not the well. Twenty-two months ago we had that water analyzed. It is not the well. It is the way you are firing; can the fireman," etc.

Your chemist can show you that quickly at little expense. I think that is enough to show what I mean by "chemical control." When I get through I will be glad to answer any questions, if I can.

Now, to keep the controlling chemist under control is an important thing. Let the superintendent who is going to have the service of the chemist hire the chemist, go over the plant with him and show him what is to be done. Your chemist does not need to know anything about a paper mill. That is not important. Pick out a suitable place where the light is good, preferably a north light, where there is plenty of warmth and not too much dirt, where he can get light or steam and electricity and gas, if possible, and put a little partition around it, with a bench at the appropriate height. Let him have five hundred dollars with which to buy laboratory equipment, and you will be surprised what a complete, fine-looking laboratory he can buy. I would not give him more than that, because chemists are like superintendents of board mills, a lot of them will buy and buy and buy until you stop them; every time you get a new chemist he will want a new kind of something or other, just as the superintendent wants a new set of boilers or a steam engine or some trifle like that.

When he is in there, start him analyzing first your water, your coal and your purchases of raw material, and have him bring the results to you without recommendations, because he doesn't know the paper business. He can tell you things you can't see, and after you have started that far, just let nature take its course, and you will be surprised how that man will become as-useful a tool to you as the pipe-fitter who doesn't run the business, but whom you tell what you want done.

---

*From an address at the meeting of the Western Board Division of the American Pulp and Paper Mill Superintendents' Association, Chicago Nov. 25, 1922

I want to tell you one little trick about the control of your chemist. It is this: I demand of my engineer, whether he is an engineer or chemist or a lawyer or doctor or an auditor, that he explain to me what he is doing so that I understand it. That is a task, but he has got to explain it so that I can understand it. In the first place, it is important that I know what he is talking about. If he can't explain it so I know what he is talking about I don't know whether he knows or not; if he can, I know he knows, and this is a certain test.

Say to your engineer, "I don't understand that. Tell it to me so I know what you are talking about." If he knows what he is talking about he can tell it to you so you can understand it.

Keep the chemist under your control; you will be amazed at the results you can get.

CHAIRMAN NICELY: What does a good chemist cost?

It is a pity, but it is true that you can engage what is called a routine chemist for as little as you can get a good bookkeeper.

American Sulphur in the World's Markets

IN the early days of sulphuric acid manufacture in Europe, practically the entire production was made from burning of sulphur. When the Neapolitan government granted a monopoly for exportation of sulphur to a French firm and the price of sulphur went up to $70 a ton, pyrites was substituted and never since has lost its place despite easily demonstrable advantages of sulphur.

In the United States sulphur has displaced pyrites and Silican brimstone which formerly composed 95 per cent of the world's supply of natural sulphur. United States production comprises 80 per cent of the world's supply. In 1892, our production was 2,400 tons while imports were 101,996. Sicilian production was 411,828 tons and exports 318,850. By 1908, American production reached 369,444 while imports dwindled to 20,118 tons. In that year, Sicily produced 404,297 tons and exported 375,073. United States production reached the peak in 1921 at 1,879,150 tons and imports were only 50 tons.

United States exports increased from 590 tons in 1900 to 477,450 in 1920. Last year, they were 285,762 tons and the current year's exports are expected to be in excess of 250,000. Sicily in 1921 produced 240,089 tons and exported 105,063.

World stocks are estimated at 3,275,000 tons of which about 3,000,000 are in the hands of American producers. Production has been brought down near estimated consumption of 1,000,000 tons annually for domestic and foreign use. With cooperation in the industry and the price stabilized at $14 to $16 a ton at the mines, which are the principal marketing points, sulphur companies are making good profits from shipments from their large stocks carried at low cost.

The Sulphur Export Association, formed by the three large American producers, Texas Gulf Sulphur Co., Union Sulphur Co. and Freeport Sulphur Co. will seek to make available new outlets for sulphur to absorb production which for some years has been in excess of demand. Rearrangement of the agencies to handle export business in Europe will be followed by an intensive campaign to reconvert European manufacturers of sulphuric acid to the use of free sulphur in place of pyrites. A more general use of sulphur in industry and agriculture also will be advocated.

Information furnished by the American Consulate in Rome refers to the continued attempts being made in Italy to meet the crisis which has arisen since the war in the Sicilian sulphur industry, due to the accumulation of large stocks which could not be disposed of, because of the high cost of production, rendering very difficult competition with the American product. An obligatory consortium, controlling the production and sale of Sicilian sulphur, was formed to reduce costs and improve the position of the product in the international market.

Several measures are to be applied, including reduction of royalties to mine owners, financial assistance in the form of an issue of bonds by the consortium, and the reduction of taxes and transportation rates. A bill before the Chamber provides that a quantity of raw sulphur on hand in the warehouses of the consortium on April 30, 1922 (not to exceed 27,000 tons), will become the property of the consortium, which will buy it at the rate of 370 lire per ton delivered at the warehouse. This stock of 270,000 tons of sulphur will be considered as distinct from any other quantity of sulphur acquired by the consortium. One-eighth of this stock, or 33,750 tons, will be sold yearly, and the proceeds of this sale will be paid to the Banca di Sicilia for bond-redeeming operations.

The price of 370 lire per ton fixed in the proposal is approximately the rate at which Sicilian sulphur is now sold in France, Spain and Portugal in competition with United States sulphur. The financial burden imposed on the State through the proposed measure will depend on the decrease from this quotation which will apply to sulphur sales in the future. The price of American sulphur is said to be $16 per ton, f. o. b., while ocean freight to Mediterranean points is about $5 per ton. This would bring the c. i. f. price to $21, or, at the rate of 20 lire to the dollar, to 420 per lire per ton. The f. o. b. price of Sicilian sulphur has been fixed at 350 lire per ton in order to meet American competition, but the Italians believe that the cost of production can be reduced to such an extent that it will be possible to sell for less than 300 lire per ton.

American Association of Textile Chemists and Colorists

The second annual meeting of the youngest specialized organization of American chemists was held at Hotel Pennsylvania, New York City, December 2, with a registered attendance of over 200. The two sessions of the day were concluded by a banquet in the evening. The old officers were re-elected. W. E. Moorehouse, Natl. Aniline & Chem. Co., Inc., was appointed to the council. The officers are: President, Prof. Louis A. Olney, Lowell Textile School, Lowell, Mass.; vice-presidents, William D. Livermore, American Woolen Co., and William H. Cady, Pacific Mills; secretary, Walter E. Hadley, Clark Thread Co.; treasurer, Winthrop C. Durfee, consulting chemist, Boston; councillors, Elmer C. Bertolet, Philadelphia Textile School; Arthur E. Hirst, American Printing Co.; Walter M. Scott, Cheney Bros.; George A. Moran, Pacific Mills; William K. Robbins, Amoskeag Mfg. Co., and W. E. Moorehouse, Natl. Aniline & Chemical Co., Inc.

* * *

George E. Chambers, formerly with Garrigues, Inc., 10 Rector St., New York, is now with the chemical department Moser & Co., Inc., 203 Pearl St., N. Y.

Government Research in Nitrogen Fixation

NITROGEN fixation is of vital national importance both in war and peace since nitrogen forms an essential constituent of explosives, fertilizers, dyestuffs, and of many other compounds used in the arts. German enterprise in becoming independent of Chili salt peter (sodium nitrate) has stimulated research in this field in every manufacturing nation. The fixed Nitrogen Research Laboratory,* Washington, D. C., established by the Secretary of War, March 29, 1919, and now of the Department of Agriculture is our government agency to promote research in nitrogen fixation and to reduce to commercial application its discoveries. In the report of Dr. Fredk. G. Cottrell, acting director, for the fiscal year ended June 30, 1922, just issued is summarized the work of the laboratory.

Fixation Processes

At the present there are three processes for the fixation of nitrogen in commercial operation in various parts of the world. These are the direct synthetic ammonia (Haber) process, the cyanamide process, and the arc process. Several others, such as the alkali cyanide (Bücher), the aluminum nitride (Serpek), and the explosion (Häuser) processes, have also been investigated on a fairly large scale of operation in several countries, but as yet can not be considered as commercially established in the sense of the other three.

In the present state of development of fixation processes in this country, fixed nitrogen can not be produced for fertilizer purposes in competition with Chilean nitrate and with ammonia obtained as a by-product in the coking of coal, except under unusually favorable circumstances. There is every reason to believe, however, that the cost of fixation can be materially reduced through further study and development. During the past year the laboratory has studied the cyanamide, synthetic ammonia, arc, and alkali cyanide processes with that object in view.

Direct Synthetic Ammonia Process

This is the newest of the three commercially developed processes and offers the greatest opportunity for further development. In this process a purified mixture of nitrogen and hydrogen is subjected to a very high pressure and passed over a suitable catalyst maintained at about 500° C. Under these conditions nitrogen and hydrogen combine chemically to form ammonia to the extent of from 5 to 15 per cent of the gases present, the percentage depending on the catalyst and operating conditions. The ammonia thus formed is removed and the uncombined gases returned to the apparatus and again treated.

The main features of this process which require further development and on which the laboratory has been engaged during the past year are: The catalyst problem, involving the large-scale production of an active catalyst, the further development of the present catalyst, and the search for new and improved catalysts; the production and purification of the hydrogen-nitrogen mixture; the development of apparatus which will stand the unusually high pressures and temperatures used; and the removal of the synthesized ammonia from the unconverted gas.

The catalyst for effecting the union of nitrogen and hydrogen is in a sense the heart of the direct synthetic ammonia process. The efficiency of the catalyst is in general very greatly reduced by even exceedingly small amounts of impurities in the gas mixture passing through it, hence the necessity of pure gas. The laboratory has developed a satisfactory ammonia catalyst and has perfected a method for its large-scale production, which is a particularly important advance in the development of the process. Research on the theory of catalytic action was continued throughout the year, since the art of catalyst manufacture can be placed on a firm scientific basis only through a thorough knowledge of catalytic action.

The production of hydrogen of required purity constitutes the main cost of the entire process, the cost of nitrogen being relatively small. The production and purification of hydrogen from various commercial sources have been studied and improvements in the method of purifying the gas have been made. The laboratory has given special attention to the utilization of waste hydrogen for the synthesis of ammonia. Such waste hydrogen now occurs in connection with the electrolytic manufacture of bleaching materials, caustic alkali, and oxygen. The individual amounts to be considered vary over a range of 20,000 to 100,000 cu. ft. per day at the different plants, but the total amount going to waste in America is large enough to be a factor of importance.

For the utilization of these relatively small quantities of waste hydrogen, methods of operation quite different from those in large installations must be considered, since some of the economies which can be introduced by large-scale installations are not possible in this case. The laboratory has developed and installed apparatus adapted to the synthesis of ammonia, using waste hydrogen. This equipment has been in continuous operation for several months and important information on the various steps of the process was obtained. This work, when completed, will provide the information necessary for the installation and operation of small ammonia plants throughout the country.

In connection with the engineering features of the process, the construction of a synthetic ammonia plant on a semi-commercial scale was begun, so that the numerous mechanical problems involved can be better studied. The plant will also afford a means of testing catalysts under conditions more closely approximating those in commercial operation.

Another problem of great importance and considerable complexity is that of obtaining a material suitable for the construction of the catalyst chambers in which the reaction between nitrogen and hydrogen to form ammonia takes place. Ordinary carbon steel can not be employed, since it rapidly deteriorates, becoming porous and in many cases so brittle that it can be broken with the fingers. To obtain reliable information on this problem, the laboratory has had under test 25 bombs made from different materials. Although the test is still in progress, very important information as to suitable materials for construction of catalyst chambers has already been obtained.

The design and development of apparatus to operate at very much higher pressure than is now regarded as commercially feasible was also undertaken, since ammonia formation is greatly favored by increasing pressure. Although this problem is quite beyond the range of present engineering experience, satisfactory progress was made and important developments along this line are to be expected.

The removal of ammonia from the gas mixture after its passage through the catalyst is a prombem of considerable importance. The difficulty lies in removing practically all of the ammonia from the mixture, of which it forms about 5-15 per cent, without introducing impurities in the gases which are harmful to the catalyst. The Bureau of Soils, in co-operation with the laboratory, has developed a promising method based on scrubbing the gas under high pressure with a relatively concentrated solution of ammonia, recovering the ammonia thus removed by releasing the pressure on the solution, and liquefying the liberated gas by compression.

---

*The Fixed Nitrogen Research Laboratory, Chemical Age, June 1922.

Cyanamide Process

In the cyanamide process of nitrogen fixation, calcium carbide is first produced by fusing a mixture of coke and lime in an electric furnace. The carbide is then powdered, heated to a high temperature, and subjected to the action of nitrogen, usually obtained by fractional distillation of liquid air, with which it combines to form a solid compound, calcium cyanamide. The nitrogen thus fixed can be transformed into a great variety of nitrogen compounds. The process has been in commercial operation much longer than the synthetic ammonia process, and consequently is in a much higher state of development.

The laboratory has made a rather critical study of the present form of the process, from which it appears that improvements leading to a drastic reduction in the cost of operation are rather improbable. The process requires a relatively large amount of electric power for the manufacture of carbide, and hence cheap power is necessary to its profitable operation. Since the manufatcure of carbide is now a standardized process, the possibility of materially reducing the power requirements seems somewhat remote. The nitrification of carbide, the second step in the process, is about 85 per cent efficient in the best commercial practice and hence offers some opportunity for improvement. During the past year experimental studies have been undertaken on the fundamental reactions involved in this process for the purpose of determining how improvements might be advantageously made in the present form of the process, as well as to obtain data which might suggest a modification leading to a reduction in cost of operation.

From calcium cyanamide an extremely wide variety of products is obtainable. Thus, in addition to cyanamide, there may be obtained by transformation processes ammonia, nitric acid (by ammonia oxidation), cyanides, hydrocyanic acid, cyanamide, dicyanodiamide, urea, guanylurea, guanidine, etc., and the numerous derivatives of these latter compounds which are becoming important in the manufacture of dyes, drugs, and explosives. Many of these important compounds cannot be furnished in quantity by any other process.

The laboratory is making a rather extensive study of the chemistry of cyanamide and its derivatives to open up this new and cheap source of numerous, useful compounds. During the past year methods have been developed for the production of free cyanamide (H_2CN_2) in quantity, for the production of urea from cyanamide on a semitechnical scale, and for the preparation of guanidine salts.

Arc Process

The arc process is the oldest and, in many respects the simplest of the three commercially developed methods of nitrogen fixation. It has the very important advantage from a military standpoint that it can be rapidly installed in case of war, and that it provides nitrogen directly in the nitrate form. Since the Government does not own an arc plant, the laboratory has given much less attention to this process, for the time being, than to the other processes. The experimental studies have been confined largely to the fundamental theory of chemical reactions in the path of the electric discharge.

During the past year the laboratory made a rather critical survey of the present form of the process, with a view of ascertaining the nature and extent of the improvements which can be made. The study showed, in particular, the necessity of improving the method of nitrogen-oxide recovery and of increasing the efficiency of furnace operation. To materially increase the energy efficiency of the process, which at the present time is very low, a more accurate knowledge of the reactions occurring in various types of electric discharge is absolutely essential. In this connection a study was made of the production of ozone by the corona discharge and the production of active nitrogen in the low-pressure arc and in an electrodeless discharge. A number of physical and chemical properties of these two highly interesting and important substances were also determined. Investigations of reactions in the path of electric discharges are continuing, for there is reason to believe that very fundamental improvements may be achieved through such studies.

Cyanide Process

The cyanide process has not been successfully developed on a commercial scale. The form of the process developed in this country consists essentially of heating a mixture of soda ash, carbon, and iron to an elevated temperature in the presence of nitrogen gas. The product is a crude cyanide containing 5-10 per cent nitrogen which can either be treated to produce a marketable form of cyanide or subjected to the action of steam to produce ammonia. Several important advantages are claimed for the process and much experimental work has been done on it in this country. During the war the Government built a plant for the production of cyanide at Saltville, Va., which was designed to have a capacity of 10 tons of cyanide per day. Although some cyanide was produced, it was shown during the short period of operation that both the chemical and engineering features of the process required further study and development.

In the survey of this process, it became evident that two types of research were necessary to its further development—research which would afford a more accurate knowledge of the fundamental reactions involved in sodium cyanide formation, and research on the engineering features, particularly the development of a satisfactory method of manipulating the charge under treatment. In research of the first type, a study was undertaken to determine the influence of such factors as quality and proportions of materials, temperature and duration of treatment, purity of nitrogen, and presence of iron, on the completeness and rate of cyanide formation. The results already obtained indicate that failure to obtain satisfactory conversion to cyanide in the semi-commercial tests which have been made in the past was due in part to the low quality of carbon and iron used. Information on the mechanism of the reaction has also been obtained, which suggests ways of improving the process.

There is some doubt as to whether the cyanide process can be so developed that fertilizer can be produced as cheaply by it as by other processes. It should be pointed out, however, that the development of a process for the production of cyanide, as a final product, directly from atmospheric nitrogen, is very important in view of the increasing demand for nitrogen in the form of cyanides. Until recently their large-scale commercial use was confined essentially to the hydrometallurgy of gold and silver ores, with smaller quantities consumed in casehardening and electroplating, but in recent years the application of hydrocyanic acid as a fumigating agent for fruit trees has opened a new and rapidly growing market of particular interest to agriculture.

Manufacture of Hydrogen

By M. Georges Claude

L'Air Liquide Anonyme, Paris, France

FOR a number of years now I have been engaged in the manufacture of hydrogen by the partial and direct liquefaction of water gas and its analogues.

Procedure

For this purpose, water gas, compressed to a suitable degree, is in the first instance deprived of its carbon dioxide and is dried. The gas is then sent into a heat exchanger, in which it is cooled by circulating in the opposite direction to the hydrogen and carbon monoxide which already have been separated. The gas then enters, by a collector, the bottom of a sheaf of vertical tubes, the lower portion of which plunges into a bath of carbon monoxide boiling under atmospheric pressure.

By the combined influences of the pressure and of the temperature of the liquid bath a large portion of the carbon monoxide of the ascending gases is liquefied; it flows back into the collector. Owing to the pressure this liquid is forced out into a vaporizer, where it replaces the liquid which is being evaporated. The remaining gas, containing hydrogen and a little of the residual CO, continues to rise in the sheaf of tubes. There the gases encounter a temperature which is more and more being lowered, by means which I shall presently explain. Under that influence the rest of the carbon monoxide is liquefied.

Theoretically, therefore, it is a sensibly pure hydrogen which escapes from the top of the tubes, and it is this cold and compressed hydrogen which is expanded in the nozzle and further cooled by this expansion to be sent back around the sheaf, in order there to produce the very low temperatures of which I have just spoken.

Recent Improvements

In working this process two sources of inconvenience were experienced, which I only have recently been able to overcome. In the first instance, when the hydrogen is arriving at extremely low temperature in the nozzle, as indicated, the frigorific efficiency of the expansion will be very low. There is in that case a "loss" of liquid, unless we go up to pressures, regrettably high from the point of view of energy expenditure, and this is all the more so because none of the customary lubricants can be employed at these temperatures. Hence there is abnormal friction in the nozzle which will again lower the frigorific efficiency.

In the second instance, the calorific mass of the gases, leaving the tubes and afterwards the nozzle and circulating about the rising gases, will be smaller than that of the latter by the whole mass of the carbon monoxide which had been liquefied by their action. As a consequence the ascending gas cannot, even assuming a perfect heat exchange to take place, leave the sheaf of tubes at the temperature at which the expanded gases entered the tubes. The final temperature of the expansion of hydrogen, therefore, will not be very low; and, in addition, this temperature will be badly utilized for the purification of the ascending gases.

These various troubles have been overcome in the following manner:

I. Part of the compressed gas which is entering the system is withdrawn from the heat exchanger E at a point M, Fig. 1, before it arrives in the cold portion; it is thus relatively little cooled. It is sent through the tube *t* into an auxiliary system of tubes G around which the hydrogen, leaving the bundle and passing on to the nozzle, is being circulated by means of the pipes L and K. This relatively warm gas will then reheat the hydrogen before its expansion and will hence increase the efficiency of the expansion process.

II. If we relied exclusively upon this means, the final temperature of the expansion would remain bad, owing to the want of lubrication and to the eventual freezing out of the residual CO (— 206° C.). We must manage to lubricate the machinery by a substance which will remain liquid when the temperature sinks below — 206°. That body cannot be petrol ether nor any similar substance, since they would all be solidified at this temperature. I have, therefore, made use of nitrogen, which only solidifies at — 211°, and which can moreover, be added to the hydrogen, before its expansion, without causing any complication, at least in cases where we are aiming at the synthesis of ammonia.

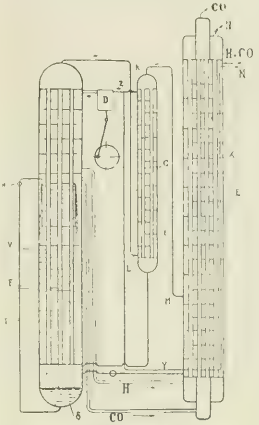


Fig. 1 Diagram of Claude Process.

A current or compressed and dried nitrogen is cooled down to about its condensation point in the heat-exchanger E by means of the tube system X Y; it is then added to the hydrogen at Z before the hydrogen enters into the nozzle. In this way, then, we secure acceptable conditions for the lubrication. As a first consequence the temperature of the escaping gas is easily lowered down to — 208° and — 210° C., as soon as we lubricate by means of nitrogen.

As a second consequence this addition of nitrogen to the gases leaving the tubular system increases, to any extent that we desire, the calorific mass of the expanded gas. The latter gas may, therefore, equal or surpass in mass that of the gas ascending in the sheaf F, including the carbon monoxide which has been condensed in this part of the tubes. As a result the temperature of expansion is considerably improved, and it is, moreover, much better utilized. We can indeed easily eliminate by these means the carbon monoxide to below 1 per cent, and the hydrogen finally isolated can without any difficulty be used in my hypercompression process for the synthesis of ammonia.

This process has been developed and put into practice in the works of the Grande Paroisse, near Montereau, where an apparatus for the production of 500 cubic meters of hydrogen per hour is in operation, feeding a unit for five tons of ammonia per day. The carbon monoxide, containing all the nitrogen of the water gas, it should be noted, is discharged at a percentage which may be easily raised to 85. The hydrogen efficiency is therefore excellent. The carbon monoxide may be utilized either for the manufacture of various chemical products or for driving the internal-combustion motors of the installation.

---

*A paper contributed to the symposium, "The Generation and Utilization of Cold," under the auspices of the Faraday Society and the British Cold Storage and Ice Association, London, October 16, 1922.

The process which I have outlined requires the compression of the gases to degrees, varying with the size of the apparatus, from 15 to 30 atmospheres. Figure 1 applies to apparatus of a capacity of 2,000 cubic meters of hydrogen per hour. This process necessitates the command of a relatively high motive power, and one might draw attention to the advantages offered by processes based upon the catalysis of CO into CO_2—such as are, for instance, employed in the Haber process. I have, hence, only studied and tried this process with a view of its ulterior application to a particularly interesting case—that of coke-oven gases, in which the presence of a considerable proportion of methane renders catalytic processes inoperative. The complexity of the gas mixtures we have to deal with in this case, and the diversity of the freezing points of the constituents, might make us fear that we should have to meet serious difficulties in the working of this process.

As a matter of fact, however, an apparatus already has been constructed for this purpose and has, after very short trials, been successfully put to service in the Béthune mines. The essential cause of the success is the very high reciprocal solubility of the diverse condensable constituents. This first apparatus has a productive capacity of 350 cubic meters of hydrogen per hour, and it is operating with a compression of about 25 atmospheres. An installation for the utilization of the hydrogen produced by means of this apparatus in the manufacture of ammonia by the application of hyper-compression has already been erected, and is actually being put in working order. I hope that this installation will be the point of departure for a much more important installation in which I intend to make use of apparatus for the production of 2,000 cubic meters of hydrogen per hour.

Process Means Increased Benzol Recovery

One of the essential reasons that make me count upon a development of this process in the coke-oven industry lies in the multiple indirect advantages which the process promises. On the one hand, since the gases to be treated must already be compressed for the extraction of the hydrogen, we are naturally led to effect the stripping of the gas of its benzol likewise under compression. All the benzol, which at present escapes when the process is carried out at atmospheric pressure, will then easily be retained; that will constitute a gain which in certain cases may come up to 1 kilogram of benzol per ton of coke. This improved recovery will, moreover, be attained by means of an infinitely reduced amount of solvent and of heat energy, and at much diminished losses of solvent. The recovery will be effected in absorption and distillation apparatus of comparatively very small dimensions.

On the other hand, the ethylene, this precious gas the percentage of which in furnace gases is too low for its successful extraction at atmospheric pressure, may easily be collected to a large extent in the course of the operations. For it will almost alone be condensed in the preliminary cold exchanger of the apparatus, and it can be extracted as a 40 to 50 per cent. mixture which will very readily be utilizable, either for the manufacture of alcohol or for use in autogenous welding or similar apparatus. To give an idea of the possible importance of this by-product, I may state that supposing the oven-gas treated to contain 1.5 per cent. of ethylene and that it can all be extracted, that would correspond to our obtaining 200 litres of alcohol per ton of ammonia, in addition to other products.

Finally, I should remark that, from the calorific standpoint, hydrogen must be regarded as the very worst of all combustible gases. One cubic meter of hydrogen represents only about 2,600 calories (lower calorific power), against the 3,000 calories of carbon monoxide and the 10,000 of methane. When we, therefore, extract the hydrogen from coke-oven gases, we in fact, enrich the gases in a true sense; and it is a considerable enrichment which they undergo, since they become fit for uses for which they would otherwise be unsuitable. When the gas is to be distributed, it will be free of every trace of the condensable impurities that cause so much mischief in our actual gas-distribution systems. When it is to be utilized as industrial gas, it will enable us to obtain extremely high temperatures and to combine, under specially interesting conditions, the production of nitric oxide by the Häusser process with the synthesis of ammonia.

These are the principal advantages of the process which I have the honor to describe. I should like to emphasize that one of the characteristic essential features of the process is the extreme smallness of the necessary apparatus. An apparatus for 1,000 cubic meters of hydrogen per hour requires a sheaf of liquefaction tubes, 40 cm. in diameter and 3m. in height.

Compressed Gas Mfgrs.' Association

Manufacturers of oxygen, hydrogen, acetylene, carbon dioxide, ammonia, chlorine, sulphur dioxide, blaugas, carbo-hydrogen, etc., have what is reputed to be the most representative trade organization in the country, practically every manufacturer of the above gases in the country being a member of the Compressed Gas Manufacturers' Association. Many manufacturers of supplies and equipment connected with these gases are associate members. The officers comprise: A. R. Brunker, the Liquid Carbonic Co., Chicago, Ill., president; A. C. Morrison, International Acetylene Association, New York City, first vice-president; Otto S. King, Ohio Chemical & Manufacturing Co., New York City, second vice-president; John H. Hayes, secretary-treasurer, 120 W. 42nd Street, New York. The tenth annual meeting of the association will be held at Hotel Astor, New York, on January 15.

Feather-Stone Insulation Co.
LOS ANGELES, CAL.

Editor, Chemical Age,
New York, N. Y.

May we call your attention to the frequent use in articles in technical journals, of the trade names "Sil-O-Cel," "Celite," "Filter-Cel," "Nonpareil," etc., all of which refer to the material known to commerce as diatomaceous earth?

We are producers of diatomaceous earth and are marketing it under the name of "Feather-Stone." In fairness to all interested in the production of this valuable material, we believe it should be referred to in journal articles under its proper name, "Diatomaceous Earth."

Diatomaceous earth has also been known under the names of "Infusorial Earth" and "Kieselguhr." We believe that "Diatomaceous Earth" is the most desirable usage, the material being composed of skeletons of diatoms. The use of the term "Infusorial Earth," in this connection, is incorrect, since the skeletal remains of Infusoria are either absent entirely, or present in inconsiderable amounts. The name "Kieselguhr" is of German origin and is not descriptive of the material.

Thanking you for your attention and wishing CHEMICAL AGE the success it so greatly deserves, we remain,

Very truly yours,
Feather-Stone Insulation Co.
[illegible], Chemical Engineer

November 11, 1922

Employment Contracts Involving Inventive Service

By Lloyd Van Doren, Ph. D.
Consulting Chemist; Patent Attorney, Duell, Warfield & Duell

WHETHER an employer is entitled to an interest in an invention made by an employee is a determination which not infrequently must be made, and various considerations enter into such a determination. An inventor, when accepting employment in which he will exercise his inventive genius, should realize that certain obligations inhere to his efforts with respect to the rights of his employer, and it is therefore desirable that a special contract covering his services should be arranged, which will set forth distinctly the respective rights of his employer and himself in any inventions which the latter may make.

These contracts should not be inadvisedly entered into, as an inventor may find himself to be indefinitely restrained from operating in the field of his experience. Accordingly, all such contracts should be carefully considered, and frequently it may be found desirable to decline to enter into them. However, a great loss may entail when an employer finds himself despoiled of important inventions developed in his works and at his expense. This is a common result of the service of unfaithful employees and warrants the employer, when availing himself of inventing services, to secure himself by fairly rigid contracts, which contracts may be said to have tended to prejudice, rather than to promote, the interests of inventors. If it were a more prevalent desire on the part of inventors to give the full result of the employment to the one who is paying for it many unfortunate contracts might be avoided.

It is one thing to produce inventions in an employer's time, and another to do creative work in the employee's time. When the inventing is in a different field from the employer's business, or is not the regular work for which an employee has been retained, it is not difficult to draw a line of distinction as to the ownership of patent rights. When such are not the cases, the line to be drawn is more difficult. In the cases mentioned, the rights of the inventor are pre-eminent; in other cases a determination must be made, in view of all the conditions and facts surrounding the employment and the making of the invention, in order to determine the relative interests of inventor and employer.

In early times, when communication was difficult between people, between portions of a country, and between nations, the field of usefulness of a person in his employment was considerably restricted. During such times the courts did not view with favor agreements limiting territorially the right of a man to pursue his occupation or vocation. By so doing, the ability of a person to earn his bread and butter might be circumscribed, something which is clearly against public policy.

In this age, however, where agreements are entered into, embodying restrictions as to time and territory, involving the pursuit of an occupation, in matters arising out of contracts of invention and employment, the tendency of the courts today is to sustain such restrictions where they are reasonable. If this were not true, a person could enter the employ of a manufacturer, obtain wages based upon his inventive capacity and the value of the inventions which he might produce and intended to be owned by the employer, obtain knowledge of trade secrets, or special efficient methods of the employer, and after a certain time separate from this employment, taking with him inventions and methods to competitors.

When agreements are made in good faith in limitation of the extent to which an employee may proceed along the above lines, it is the view of the authorities that contracts of employment restricting the employee should be sustained, the resonableness of the contract being, of course, always a question of importance. So it is that while a court may in some cases restrict an employee from entering a competing business for a period of two years, such a restriction for ten years might be deemed wholly unreasonable. When phases of coercion enter into the circumstances of the contract, and where an employer seeks to take an undue advantage of an employee under such contracts, the extent to which courts will go in sustaining an agreement may be considerably limited.

Calcium Arsenate

The boll-weevil pest, to control which the Government has spent over $500,000 in experiments and whose depredations are felt in an annual reduction of 4-6,000,000 bales of cotton, not only has profoundly influenced the economics of the South, but is felt by every consumer of cotton fabrics and other products of the cotton plant. The efficacy of calcium arsenate as an insecticide has stimulated the demand to the degree that chemical enterprise to provide this compound is depended upon, aside from improved cultural methods, as the present chief source of relief.

Dr. Frank K. Cameron, formerly of the Bureau of Soils, has worked out the only new process whereby the arsenic supply may be increased over that provided as a metallurgical by-product. The Salt Lake Insecticide Co., Salt Lake City, Utah, of which Dr. Cameron is manager, has built a plant to extract from scorodite, which is an arsenate of iron in which the arsenic has undergone oxidation to As_2O_5, the arsenic as sodium arsenate which is transformed readily into calcium arsenate. As the only commercial deposit of scorodite known is in Utah and controlled by this company, its service in increasing the supply of this insecticide will be watched with interest.

The Geological Survey announces production of refined and crude arsenic in the United States in 1922 as 10,947 short tons. The sales of crude arsenic amounted to 1,366 tons. All the crude arsenic sold was used in making sodium arsenate, a weed killer, either at the place of manufacture or at places nearer the consumer. The production of refined white arsenic having a purity of 99.5 per cent. or more amounted to 9,581 tons, valued at $1,486,000, or 7¾ cents a pound.

Six western smelting plants that handle copper and lead ores, and are equipped with arsenic refineries, made white arsenic, crude and refined, in 1922. The American Smelting & Refining Co., which operates the plants at Globe, Colo., and Tacoma, Wash., reported the largest output. The Anaconda Copper Mining Co. had some difficulty in getting sufficient labor to operate at greater capacity its ore-reduction plants at Anaconda, Mont., but reported the second largest output of refined arsenic and the largest output of unrefined arsenic. At the plant of the United States Smelting, Refining & Mining Co. at Midvale, Utah, the output consisted of refined white arsenic, of which a normal quantity was sold. All the company's crude material was worked up into sodium arsenite solution, many thousands of gallons of which was distributed to railroad companies for killing weeds on rights of way.

IV. Random Recollections of An Old Professor

Conclusion of a Notable Autobiographical Sketch of a Well-Known Chemistry Teacher and Chemical Technologist

By Edward Hart, Ph.D.
Professor of Chemical Engineering, Lafayette College

JAMES GAYLEY was a student when I came to Lafayette. He took the course in mining, and spent much time in the laboratory without specially distinguishing himself, but as soon as he got to Catasauqua he began to develop. I have told about this part of his career in the *Jour. of Ind. & Eng. Chem.*, vol. 5, p. 247. I say there:

"After leaving college he often came back to commencement, and I saw him once or twice in Pittsburgh. I had been plugging away at chemistry in Jenk's Hall, which was the chemical laboratory from about 1881 to 1902. I taught descriptive chemistry, analytical chemistry, organic chemistry, theoretical chemistry, chemical technology, assaying, blowpiping, metallurgy and scientific German. During the intervals I worked for a living. Our laboratory was poorly equipped and I was very short of books. One day Mr. Gayley came in and after some general talk suggested that I get up plans for a new laboratory. I had heard that sort of suggestion before from others and nothing had come of it. So I acquiesced but did nothing. Some months afterward Mr. Gayley again suggested that I get up plans and said that he would pay for them. I consulted the President who told me that Gayley had made a lot of money and that he was probably in earnest. Then I consulted an architect, and in a short time Gayley Hall was in full blast. Imagine my feelings! For twenty years I had labored with my college work as one almost without hope, when suddenly all my wishes were fulfilled and I found myself with a handsome well-equipped laboratory, an endowed library and assistants enough to enable me to do really good work."

Gayley became a Trustee of Lafayette in 1892. He was a working Trustee and was interested in College matters. He gave of his time as well as of his means He often gave money to the boys who needed help and he was glad to help the Faculty members in their work In return he often asked for counsel from us and took our advice. He was a great blast furnace engineer I have in my hand as I write a copy of "The Story of a Grain of Iron," which he wrote.

In Sweden

In 1903, just before the meeting of the Society of Chemical Industry at Bradford, I visited Sweden in company with my son Richard, and at Fahlun made the acquaintance of Ackerman who was in charge of the Stora Kopparbergs Bergslags Aktiebolag, which is probably the oldest copper mine in the world, dating from between 1200 to 1250 A.D. Ackerman spoke English well and was very kind to us. He ca'led on us at the hotel and after dinner took us to the mining museum of which he was Curator and showed us many curios which it contained. Among them was a model of a double overshot water wheel used in hoisting ore, figured in Agricola, but which he assured us was in existence before "de re Metallica" was written. Another curiosity was a lock 250 years old and alongside a lock made recently by the Miller Lock Company of Philadelphia and patented in the United States with exactly the same mechanism.

The purpose of our visit to Sweden was to learn more about the filter paper made at Gryksbo. We had been selling this paper for several years and hoped to make better arrangements for a supply. Here we met the Munktells, of the second and third generation, and they kindly gave me a picture of the grandfather, who, acting upon a suggestion of the great Berzelius, had founded the business. One of the sons spoke English very well and his father spoke German as well as I did, so we had a fine visit. The filter paper, we found, was wetted and hung on poles to freeze. This "plumps" the paper and facilitates filtration.

In Italy

In 1906 I attended the International Congress of Applied Chemistry at Rome. In connection with this we went to Lardrello and saw the soffioni where steam-carrying boracic acid issues from the earth. We were entertained by Prince Conti, a son-in-law of Count Lardrello, who took us through the works and showed us the machinery for grinding the acid, actuated by steam of 60 lbs. pressure from mother earth. This is first purified and then used in the steam engine.

Teaching Chemistry

And now I must speak of the teaching of chemistry and some of the teachers of my day. The study of teaching as an art had only just begun. Pedagogy was taught in the normal schools, but only to those who taught in the common schools. Dr. Moore once recited his first lecture in chemistry to me something like this: "We will begin our study of chemistry by a study of Oxygen (I had never heard the word). We will make the gas (I had never heard the word gas) by heating a mixture of potassium chlorate (never heard of it) and manganese dioxide (never heard the name) in a glass retort (never heard the word retort) placed on a tripod (knew tripod must mean three feet) over a Bunsen burner (never heard of it) and collect it in a bell jar (didn't know what that was) over a pneumatic trough (Pheu! What is that?)."

This was soon after my work as a teacher began. I immediately questioned my own method, to find that it was not much better. Then I began to study methods of presentation, and I remembered how fascinating I had found Asa Gray's book on botany. Asa Gray's method was evidently the best and it consisted in using short sentences, very clear statements and leading up from simple things to complex ones so quietly and skilfully that the beginner became an adept without realizing the difficulties. He found the study easy and fascinating.

How was I to do this with chemistry? Worst of all how was I to interest a class of say sixty students with little chance to quiz them individually? The clue came with a German book which Dr. Knox sent me from Germany. The author of this book did not himself realize that he had the key. The man began with the metals. "Now," said I to myself, "the boys know quite a few metals." So I began by saying "How many metals can you name?" They all knew [illegible]. Well what color has it?" "Black," was the answer. "Wrong," I said. "File off the surface and see what the color is." In the same way we studied copper, lead, silver and a few others. Then I asked why it was that the iron had a different color on the outside from that below the covering, and a few said it had rusted.

"Well, does copper rust?" A few knew that it had a green rust and some thought the rust was black or brown. I told them that we called these rusts oxides, and that we had discovered that metals would not rust unless air was present. If they were kept in a vacuum no rusting occurred. Then we had one of the familiar experiments to show that when metals rust the rust weighs more than the metal, so it must have taken on something. Then I showed how this something could be separated from red lead and mercuric oxide. It was the gas oxygen. Then I explained what we meant by a gas and what it was supposed to be. This led to a talk on other gases. Then their combinations were studied.

I told them then that all the metals were elements and explained what this meant. I soon discovered that a few boys needed extra help, and got them to stay so that I could give it. A few boys ran ahead of the others, these had extra work to keep them busy and interested. I was aiming to give the boy of average ability what he needed—a clear but imperfect idea of the subject which could be filled in later on.

Teaching organic chemistry was much more difficult and I succeeded only after many failures. The successful method was this: I put sticks of wood in an iron retort and passed the gases through a condenser. The gases escaped, but we tested them to see what they were and about how much there was of each. The condensate was fractionally distilled, neutralized with lime and methyl alcohol separated. This was converted into methyl iodide. Acetate of lime was prepared and heated to give acetone, and this was converted into chloroform and iodoform.

No explanations were given during these operations, but the boys became very much interested and grew intensely curious. Then we began with the ordinary method to teach them organic chemistry. The ground had been prepared and the seed sown. The plant grew apace. The boys told me that organic chemistry was hard but very interesting.

In examinations I give fifty questions, all requiring short answers such as: "What color has copper sulfate?"; "Is bromin solid, liquid or gaseous?"; "Has phosphorus metallic luster?"; etc. Examinations were written so that they had time to think, and I told them beforehand that I did not wish to condition them and would not do so if I could avoid it, which they occasionally believed. In this way I could determine positively how much they knew.

Some Teachers, Their Methods and the Men I Taught as Boys

There is no calling that calls for more absolute self-surrender than that of the teacher. To be entirely successful, he must work with his boys or girls far into the night; he must love children; he must learn how to teach and study individual peculiarities and accommodate himself to them. It is because they possessed this love and this spirit of self-sacrifice that W. L. Dudley and Edgar F. Smith were such great teachers. It is very desirable also that the teacher be of and with the things he teaches. The boys knew that these men were attending conventions of chemists, that they were a part of the present movement and were men of consequence. Their love for their teacher became a monstrous pride in him—sometimes almost grotesque.

When I go over in review the boys I have taught—now Presidents of colleges, Mayors of cities, Judges of the courts and the like, I, too, feel pride that I have been able to help in the great task, and when commencement comes and the boys come back to hail me with the affectionate shout, "Hey, Buddy!," I feel happy that they can forgive my imperfect work and feel good-will for me in spite of it. In the colleges we meet the best men in their happiest period. Even if we be not the equal of most of them we are with them and of them.

I never heard Dr. Morley lecture to his students, but I imagine that he must have been a great teacher and so must Dr. Wiley. They were linguists and masters of the language; they were kind, painstaking and patient; they were distinguished and commanded respect.

I find that telling about the teachers I have known is a short task, for I have heard so few teachers of chemistry at their ordinary work. Dr. Mallett used many samples to illustrate by appealing to the eye. I think this indispensable. Dr. Chandler used this method also. In delivering a lecture, Dr. Chandler put a piece of paper with some notes beside each piece of apparatus. He would pick up each piece in turn and talk about it in the most charming and informing way. He had delved in the byways and knew much more than the average teacher.

Drown's method of teaching was individual. He would go to the student's desk, greet him cheerfully, ask about his work, talk it over and make suggestions. The students were friends of his and were treated as such. Remsen enjoyed lecturing. He was a good talker and told a good story. Morse, who was his assistant for a while and afterwards Director of the Laboratory, interested me very much. He was a large man, rather slow of movement, very kind, full of information of a very practical sort. Lyman B. Hall, who afterwards went to Haverford, was a great friend of Morse. They had been at Göttingen together. There was another Hall at the Johns Hopkins who discovered the "Hall's effect." We distinguished between them by the names "Black Hall" and "White Hall." Lyman B. was light complexioned, and the man of physics dark. I think Lyman B. must have made a good teacher. He was a good talker. He was very well-informed and was full of small talk of the best kind.

I once heard Mabery lecture to a class of beginners. He was a young man at the time and he impressed me as full of promise, which was amply fulfilled after he went West. Dr. Carrington Bolton frequently delivered public lectures at the meetings of the "A_3S," which enabled us to gauge his ability. I think McMurtrie must have been a good talker to the boys, but his early opportunities had been limited, as in my own case, and he always worked under a great handicap. In many things he distinguished himself and he was a hard, indefatigable worker in everything.

I taught classes in chemistry for several years at Miss Dana's school for girls at Morristown, N. J. It was a good school and the girls were the daughters of substantial people. I was interested in watching their ability as compared with boys of the same class. I concluded that they were more faithful in getting their lessons, but were poor when left to themselves; they were good followers but poor leaders. This conclusion was verified by the experience of others who had taught both sexes. Whether this be a sex characteristic or is due to the effect of different environment and training I am doubtful.

Another phase of teaching chemistry led me to conclusions which appeared to differ materially from those of most of my colleagues. It was in the thesis work which we required of all the chemical students. I found that if left to themselves more than nine-tenths of the men who were to graduate were incapable of working out a satisfactory thesis and some of them appeared never to attain this ability. I constantly marveled at the theses which were appearing from other laboratories with results which I could *never* get. I concluded that a very large part of this good work must be not that of the pupil but that of the teacher, or which he had, perhaps unconsciously, instigated. But I also concluded that this was bad teaching. Our object was not to get these boys to do a lot of extra work for our glorification, but to teach them if possible how to do research work. They were birds about to fly the nest; it was our duty to teach them to fly. I therefore gave very little help to such men unless they became discouraged.

I remember well how this plan resulted with one of my brightest men. After he had worked hard and faithful until it was time to write his thesis he confided to me that he was disgusted with himself. He said he had not obtained a single result of value. "Oh, yes, I think you have," I said. "If I were to set you at it now, could you get any results in the time you have spent?" "Sure I could," he replied. "Well," said I, "then you have learned to fly, haven't you?"

I am convinced that one of the greatest hindrances in teaching is the false ideas instilled into the child by the mother, or occasionally by the father. The idea of caste distinction does much real harm, especially the idea firmly established in many children that the blood in their veins is blue. Another idea hard to eradicate is that college boys belong to a superior class and need never work with their hands. Such ideas soon become basic; they are seldom acknowledged but always felt, and are to the last degree both pernicious and anti-Christ.

Just Faithfulness to the Job

As I finish these recollections and look back upon my career, I do not find in it anything that might not have been accomplished by the average boy. As compared with the opportunities which now exist mine were rather poor. Many a time I have tackled jobs beyond my strength and finally succeeded in accomplishing nearly everything I had undertaken tolerably well. If the work required extra exertion and time, I gave it. I often stayed away from games of various kinds to do this work, but this I have not regretted. The man who undertakes tasks that are within his strength and succeeds finds great pleasure in accomplishment. Looking back, I can see many places where I might have been kinder, more industrious and more persevering.

I was raised among the Hicksite Quakers and from my mother imbibed many of their ideas. This was a poor preparation for a professor in a Presbyterian college, but I have been able, nevertheless, to live in peace with them and make many friends among them. I have had the pleasure of seeing many of my old time pupils become Trustees of Lafayette, and all of them are my friends. One of the great compensations that come to the teacher who stays in one place and tries to do a better piece of work each year is to meet the boys as they come back, to look in their eyes and find that the recollection of what he tried to do has blotted out all recollection of his imperfection.

Let the Young Chemist Note This

I think the young chemist, if he be wise, will try first to find associates where he may feel at home. After he has found this place he should try to please his superiors. This is not usually very difficult. Then he should stick to his job and not move from place to place.

The man who moves whenever a raise in pay is offered makes a serious mistake. Then, as soon as possible, he should try to become specially well-posted and keep posted upon some part of the great field opening to all of us. If it is practicable he should become his own boss, though no one ever can become so fully his own boss as to pay no attention to the wishes of others. A man who can do some one thing much better than any one else in course of time inevitably becomes his own boss and the boss of others.

Why Should the Scientist Take the Vows of Poverty?

I do not believe in the idea that the scientific man should gladly face a career of poverty. Poverty may be no disgrace but it is packed with inconvenience and limits one's opportunities shamefully. The cultivation of an income sufficient for one's needs is not incompatible with high scientific attainment and such an income is full of comfort when there are shoes to buy and children to educate.

A Little Child Shall Lead Them

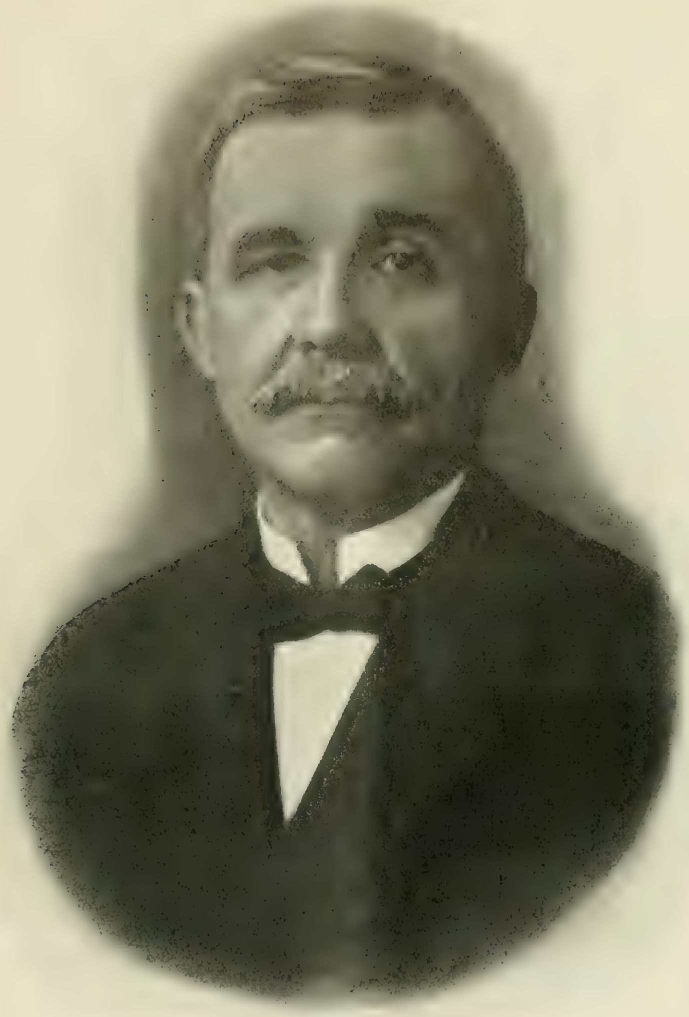
Nether do I sympathize with those misguided people who will have no children—far too common now among the elite. Children, more than anything else, teach us self-denial and the beauty of sacrifice to those we love. More than anything else they lead us into the paths of peace and keep us there.

But the cultivation of an enormous income for the sake of display, or even for the purpose of excitement seems to me to be a mean and ignoble ambition. I have tried to be useful and I do truly believe in the Rotarian motto that "He profits most who serves best."

Writing Society Editorials
Chemical Engineering Education

There is a great tendency in many of the modern societies to conclude that they are possessed of about all the wisdom under the sun. This is manifested by the writing of editorials which are more or less wise, often less; and by efforts to standardize a lot of things that do not need standardization. The Institute of Chemical Engineers, for example, has underaken to standardize a course in chemical engineering and make it universal. If you were to ask a dozen chemical engineers to define chemical engineering you would get a dozen answers, all different. The answer is, then, as regards vocational schools: In each locality concentrate on the subject locally important and give an intensive course; but do not try to teach a man to be expert in sugar making, sulfuric acid making and the manufacture of salt or soda ash in four years. The man who can do one of these well can soon learn to do others well. Because this has not been seen, five, six and seven-year courses have come into vogue; but they are too much of a strain on the parents' pocketbook and upon the student's time. If we carry such courses to their logical limit the poor student will reach middle age without earning a cent.

C. L. Bryden, filtration engineer, Lafayette '02, addressed the Gayley Chemical Society, Lafayette College, Easton, Pa., on December 11 on "Filters and Filtration."



Edward Hart, Ph. D.

Professor of Chemical Engineering, Lafayette College

The Chemist as a Citizen

"Random Recollections of an Old Professor" leaves uppermost in the reader's mind the value of Dr. Hart's example of the chemist as a citizen. Rarely is found among chemists that combination of diligence, versatility, capacity for friendship, usefulness to the community and inspiration to associates that overflowed a busy and ambitious life for his institution to grace his relations as a citizen.

In the fifty years' perspective of his experience, which Dr. Hart with engaging good nature has shared with American chemists, is disclosed the way that chemists must travel if the tribe is to attain that popular esteem desired as practioners of a great technical profession, but to which they are entitled only as they earn it by the assumption of the responsibilities of educated men in a democracy.

Nearly two thousand years ago the formula was given to man; at this appropriate season Dr. Hart submits it to the American chemist in that slogan of success:

"He Profits Most Who Serves Best"

CHEMICAL
AGE

Volume 30
Number 12

December
1922

A Consolidation of
The Chemical Engineer
and Chemical Age

EDITORIAL

IN the face of the judgment of the exhibiting element in chemical manufacture committed to a biennial exposition and of the general opinion in equipment production that its wares do not warrant expensive display every twelfth month, the International Exposition Co. and Charles H. Herty are determined that there shall be an annual exposition of chemical industry. The showman clings to the management and profit of the enterprise despite sentiment that demands its mutualization and its conduct consistently with industrial conditions, while his co-worker declares that "future success of chemical industry depends upon united effort" in support of the International Exposition Co.

We would not minimize the value to the industry of a comprehensive exhibition of chemical tools, materials, supplies, processes, products and education, presented in a manner intelligently co-ordinative that the maximum value of such effort may be realized, and managed with an eye single to harmonious satisfaction of exhibitors. We would, however, magnify, that its anomaly may be appreciated by the industry, the high impolicy of permitting to grow up in chemical industry an organization and a system that transform service to an industry into working an industry.

This organization and system, with affiliators who profit from their place in the system, flout the judgment of those whose support makes an exposition possible and force upon an industry an exposition whether it wants it or not.

Relying upon tricks of salesmanship and the acceleration of opinion by the affiliators, expositions certainly can be held annually, but they will not be "chemical" expositions, for there is nothing in the manufacture of chemicals either inherent in them or in technological progress in the multiform arts of their production that warrants a display every twelfth month. This fact is demonstrated by the character of past chemical support of the Chemical Exposition, the chief part of which has come to be our voluble and omnipresent friend, for his clients have been conspicuous by their absence. Accordingly comes the conclusion that chemical manufacture is satisfied to have chemical equipment and supply manufacture pay the advertising bill of the "Chemical" Exposition.

This attitude on the part of chemical manufacturers is not the result of a desire to get something for nothing but of the conviction that the show as an annual affair in so far as their activities are concerned is not worth while; and so we are confronted with a potent contradiction of Dr. Herty's declarations and with its companion conclusion that the minister plenipotentiary of synthetic chemistry demands an annual show as an opportuity for personal exercise and of association with the heavy tragedian of the troupe.

Nothing is more certain to "widen any breach in our ranks" than to seek to force upon chemical and allied industry an organization in which it has lost confidence and to perpetuate methods and management and a system at which it rebels.

IT certainly is clear to you that Chemical Age favors a chemical exposition as the co-operative enterprise of the industry itself, as is amplified in the article on pp. 531-532, in which advocacy it displays courage, intelligence and a disinterestedness notable because of their absence elsewhere in public discussion of this subject.

You don't get solidarity by doing things for people for the benefit of the donor, for not only is this job a thankless one but it leaves their minds too free to criticize the commercial philanthropist and to bicker among themselves. Cohesion is best enforced by the compulsion of a common responsibility enthusiastically entered upon and carried out as conditions warrant and not as a system, that would subvert the normal for the sake of the perquisites and profits of the abnormal, dictates.

The International Exposition Co. deserves credit for initiating the Chemical Exposition which as an educational institution has undoubted merit, and like all institutions designed for material service to a class it must adapt itself to the sentiment of those it would serve. This institution being intimately of the industry is the industry in its public presentation, and faithfully to reflect the life and service of the industry it must have a spontaneity impossible in an institution worked for the private profit of the promoter.

The mutualization of the exposition enterprise whereby it may express the wishes of its supporters and the needs of the industry is as natural as the conviction of the citizen under the restrictions of free institutions that he can do as he pleases with what is his own. For the servant to dictate to the master and for the system openly to impugn the capacity of chemical industry to conduct a co-operative chemical exposition when, where and how it pleases is as contumacious display of ingratitude as ever marked chemical journalism in America. The industry demands a new deal from a fresh deck.

THE article by Dr. Clarke of the Department of Chemistry, West Virginia University, on page 527, in which he describes preparations for turning out chemists in West Virginia, and the address of Mr. K. I. Herman, on page 533, in which he states that a good routine chemist can be had for the wages of a bookkeeper, present the Alpha and Omega of the irrepressible problem of making a living at chemistry.

There has been so much flamboyant adulation of the chemist by our Society that its embarrassment in the present situation, which will be relieved but little by the resumption of industrial activity, cannot be concealed, in fact is disclosed by the gingerly way it discusses the bread-and-butter problems of chemically trained men. This, however, should not be unduly emphasized, for it is not within the purview and cannot be reconciled with the functions of a scientific society to be concerned with the material welfare of men whose increase in numbers it is designed to promote. Absorption of this responsibility in a vain attempt on the part of a few men to monopolize and control the activities and aspirations of chemically trained men only will result in such an agglomeration of contradictions that, Babel-like, further dispersion will be the result.

The rank and file of American chemists are individualistic and have come to resent the over-weening attitude of a few that they alone know what is best for a great educated class of industrial workers. The truth is that chemically trained men have become disgusted with the idea that they are a flock to be herded and expected to move when the horn is blown; and equally is it the truth that such behavior has been very much the fact. This condition is reflected in the inferior economic status of practitioners of chemistry and in the discouragement by interested people of the practice of common-sense ways to improve that status.

Heralding an improvement in industrial activity; mildly reproving manufacturers for discontinuing chemical employment as though an industrial plant's sole excuse is to provide jobs; urging chemists to acquire such versatility that they can find employment in non-chemical work in times of stress, is such class of encouragement to professional workers in chemistry as condemns the leadership. If American chemists are going to attain the recognition their work in industry entitles them, they must do it themselves and along lines concerned solely with the personnel and independent of the politics and machine control of our scientific society.

WE have as the two poles of the system of chemical employment the teaching chemist and the employing chemist, with the product of the former being turned out in numbers and quality at a rate more rapidly than the latter can find in chemical work a means of livelihood for them. Never before has the teaching chemist had a greater responsibility, nor the employing chemist a more impressive realization that it is quality not numbers that counts in chemical progress.

The growing chemical student population, reflecting as it does the increasing popular appreciation of the industrial value of chemical knowledge rather than any value that chemical science may have as a cultural study, has made imperative the exercise of selection and the scrutiny for and encouragement of the exceptional by the teaching chemist. The teaching chemist's responsibility for the character and capacity of the trained novitiates of industry only can inure to a greater appreciation of his importance to industry.

The employing chemist hires chemically trained men in the same way he buys his raw materials; he takes advantage of the market to procure the highest quality at the lowest price consistent with the service expected. When the market for chemical service is a buyer's market and which from every indication of present and prospective facilities for turning out chemists it will continue to be despite all progress made in educating manufacturers to the utility of the chemist's work, it behooves chemically trained men to study ways and means whereby conditions of the market for their service may have such stabilization as will contribute to their self-respect and to pride in their profession.

Farthest from the minds of the many men who are giving this subject study is the idea of creating any instrument of oppression condemned not only by its futility but by the character of the American chemist. Closest are plans whereby production and consumption can be coordinated and that solidarity created whereby members of the class may attain a measure of that standardization insisted upon by the employer for his products. This is the most important subject that can engage the attention of American chemists. That it has been so long delayed is the result of our faulty system of chemical segregation and of the power therein of men who believe that the machine is more important than the man and of the acquiescence and indifference of others disinclined to disturb the system, and, most important, of the fear of others, eager to promote such enterprise, to bring upon themselves the disapproval of those whose favor they seek.

THE rank and file of American chemists demand new leaders; only a short period of frank, intelligent discussion of his material problems has been necessary to impart insistence to this conviction. They will not get them unless they create them out of men who see the necessity of new men, new measures and new methods to aid in the solution of problems natural and inseparable from the growth of consciousness of kind which a scientific society controlled by politicians never can express.

Observation and experience have demonstrated that chemical education alone will not carry them through;

that a highly specialized service is like a commodity whose highest measure of satisfaction in use demands study and knowledge of the market that the most satisfactory supply, distribution and utilization may be had; that stabilizing conditions of livelihood in a great technical profession requires such class of organization that it can perform the same service to its members as is done by cognate organizations concerned with the production and use of these members.

These three types of organizations have such clearly defined responsibilities that their interrelation makes them as the three legs of the stool to support the public service of chemical industry. Do you not see that the absence or failure of one leg has much to do with the deplorable employment conditions of a great educated class, which never markedly will be alleviated until it is supplied? To combine the functions of two legs into one is at a continued sacrifice of stability of the stool, but with such measure of satisfaction to the other leg however, that the arrangement still serves after its fashion.

The body of chemically trained men in America has become so great, and the development of the economic instinct so engrossing, that satisfaction of the new outlook will not lie in a subsidiary division of our scientific society, dominated by the influence of those who are interested to suppress any exercise of that instinct save that which they think is proper for the body. The younger element of American chemists demands opportunity of broader exercise of the creative impulse which has overflowed the confines of chemical education and practice into activities that will have expression in a strictly professional economic organization. The leadership of the past decade lags superfluous and hangs as an incubus upon aspirations that will be realized.

WE are reproducing here the remarks of Dr. E. F. Armstrong, F.R.S., president, Society of Chemical Industry, the significance of which will be appreciated by those readers who recall the brief history of the Institute of Chemistry of Great Britain presented in August, 1921, CHEMICAL AGE, wherein was set forth the futility of the antagonism of the Chemical Society of London, forty years ago, to the establishment of a professional economic organization of English chemists, and the close analogy of present-day conditions to those obtaining at that time as regards the establishment of the American Institute of Chemistry.

Dr. Armstrong's remarks are of especial significance to American chemical politicians obsessed with the determination that there shall be monopoly of control of all chemical organization activities. He outlines the functions of the various British chemical societies in the English system of segregation which futilely are sought in America to be combined in one society by a handful of select men with such results as spell only failure and dissension. Dr. Armstrong remarks, on the occasion of the meeting on November 6 of the London section of the Society of Chemical Industry, show that now the Society of Chemical Industry also recognizes the consistent, natural place of a strictly professional organization as distinguished from the educational society on one hand and a trade organization on the other.

The subject which concerns all members of the chemical fraternity, more than anything else at the moment, is the means of our livelihood. The Chemical Society of London has entrusted to it the safeguarding and advancement of chemical science. The Society of Chemical Industry has rather different functions to fulfil, functions which I would like to suggest to you call for other qualities than those of being, I will not say a mere chemist, but merely a chemist. "The Society of Chemical Industry" was the title given to us by our founders, 41 years ago, but today I think we ought to call ourselves the Society for the Promotion of Chemistry in Industry.

It is very difficult to define chemical industry; those who formed the Association of British Chemical Manufacturers had very much wider ideas as to what was a chemical manufacturer than has proved to be the case. Those engaged in many branches of manufacture, who, it was thought, were chemical manufacturers, have chosen to regard themselves, not as chemical manufacturers, but as manufacturers of a particular article, and, in consequence, have not allied themselves to the chemical industry. I fear that the tendency at the present time is to restrict more and more the term "chemical industry" to the very definitely chemical industries. If we take as our title "the promotion of chemistry in industry," then nearly all industries become chemical industries, because chemistry is at the foundation of all.

The efforts of the Society of Chemical Industry are supplemented today by the Institute of Chemistry, a body which is worthy of all praise. There was, in the past, a tendency to confine the Fellowship of the Institute to the restricted, although eminent, classes of chemists known as consultants and analysts, but that tendency has gone, and today the Institute is enrolling within its ranks, either as Fellows or Associates, everybody who is worthy of being called a chemist.

In addition to the Institute of Chemistry, we have the British Association of Chemists, of which I have a very high opinion. I regard it as the left wing of the party, and a party without a left wing is almost no party at all; we must have stimulus from within.

I think both the Institute of Chemistry and the British Association of Chemists, and certainly ourselves—the non-political mother society—have all the same mission. We want to see the status of the chemist placed on a high plane, and I shall regard it as my duty, whenever you give me the opportunity to speak publicly, to state the fact as clearly as I can for the benefit of the outside world, that we chemists do claim to be a body of very highly trained, highly skilled professional men. Our training has been that of method, scientific method.

Still more, some of us are in the position of exercising constructive thought, and I want to put very definitely that the nation has in its chemists a body of men in whose hands a great deal of the future of civilization rests. If we are to take up this honorable position that we claim for ourselves, we must, like the doctors and the lawyers, have a very high standard of professional conduct. Remember, the British public is our judge.

I want to enter a strong protest against the action of certain chemists in misleading the public. I do not think any chemist has any right to set his name, much less his qualificaions, to documents which are published in company prospectuses and elsewhere with intent to mislead. Of course, I am making these remarks without reference to any individual. I wish to emphasize the necessity of no chemist setting his name to documents that may mislead the public. The public is essentially gullible, but it has a long memory, and if Mr. X——, F.I.C., F.C.S., deceives the public once, the public will in future regard all F.I.C. and F.C.S. as of the same stamp.

It is also time publicly to enter a protest, not against the use of the term "chemist," because that has long since passed beyond our control, but against the qualified chemist in any way doing anything to perpetuate the existence of the unqualified chemist. During the war, the mistaken policy of the Government in sending chemists into the trenches caused a shortage at home and all sorts of unqualified men had to be brought into the factories. They did their work and it is to their credit, but during the recent trade slump the employer has parted with these men gradually, not generally realizing they were representing chemists, and I fear that it will take a considerable time to live down some of the errors made at that time.

II. Appliances for Moving Liquids in Chemical Plants

By A. K. Fischer

President, Schutte & Koerting Co.

IN the preceding article was discussed the application of the syphon and air-jet lift for handling liquids in chemical plants. In this concluding article, the vacuum lift, pneumatic displacement, diaphragm and rotary pumps adapted for use in chemical manufacture will be described.

Vacuum Lift

The so-called vacuum lift is a simple device for elevating certain chemical liquids. As shown in a typical installation, Fig. 19, it consists of an elevated tank and a steam-jet or air-jet exhauster for maintaining the tank under vacuum. After the tank has been filled, the exhauster is shut off and air automatically introduced into the tank through the exhauster, thereby destroying the vacuum and allowing the liquid to flow by gravity to the process tanks. The vacuum lift is used for emptying acid drums and for lifting very heavy viscous liquids in small capacities.

Fig. 20 shows a steam-jet exhauster effecting the transfer of liquid from a tank car to a storage tank by means of an ordinary syphon pipe. The storage tank must be located below the tank car. The storage tank can be made of cast iron, lead lined, or enamel lined, according to the acid to be handled. Also is shown in Fig. 21, how a liquid can be elevated by means of a combination syphon-pipe and air-jet lift arrangement to a storage tank at a higher elevation than that of the tank car. The air is first evacuated from the syphon-pipe before it is put into operation. This is accomplished by the exhauster. After the flow of the liquid through the syphon pipe has started, the upper stop-valve SV and the exhauster E are shut off. The liquid, now lifted by means of the syphon action alone, is passed to the air-jet lift and thence elevated to the overhead storage tank.

Pneumatic Displacement Pumps

Pneumatic displacement pumps are known in chemical industry as blow-cases, acid eggs or montejus. They are essentially closed tanks made of cast iron or stoneware into which the liquid flows by gravity. The method of operation is simple; compressed air acts upon the surface of the liquid in the tank and forces the liquid to the required elevation. While the blow-case is being filled, the supply of compressed air is shut off and the air pressure in the blow-case is relieved by means of an air relief valve.

Blow-cases are operated either by hand or automatically. When hand operation is used, a large container or tank is required in order to limit the number of times the tank is filled and emptied when a given quantity of liquid is pumped. Modern practice prefers the automatic blow-case, in which the supply of compressed air is controlled by means of an automatic air device. A sectional elevation of a typical automatic blow-case is shown in Fig. 22, in which appear the positions of the several parts when the case is filling. The blow-case illustrated consists of a tank and an automatic air device by means of which the compressed air for operating the blow case is automatically admitted and cut off at intervals.

A plan and sectional elevation of the automatic air device is shown in Fig. 23. The device consists of a valve plate in the center of which is an opening having a conical valve seat which communicates by means of two radial ports or tunnels (see plan view in Fig. 23) to a circular or annular chamber, which in turn connects with the compressed air inlet. A number of vertical cylindrical ports or surge holes are provided around the valve seat. To the valve plate or disk is attached a cylindrical chamber in which moves a piston disk, which is a cylindrical plunger, to which are attached a number of radial segments that permit the disk to move with a minimum of friction. The bottom of the disk terminates in a wedge or inverted cylindrical cone designed to make an air-tight joint with a conical seat in the plate. The top of the piston disk is provided with a flat circular seat which likewise makes an air-tight joint or contact with the flat circular seat on the exhaust port of the cylindrical chamber.

Operating Blow-Case

The operation of the blow-case and automatic air device is readily understood by referring to Fig. 22. The liquid to be pumped flows by gravity from a supply tank through the check valve into the blow-case, and fills the case until the liquid comes into contact with the bottom of the piston disk. As the liquid raises the piston disk from its seat, the radial ports are uncovered and compressed air admitted into the blow-case. Under these conditions

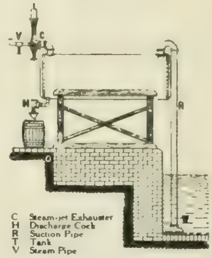


Fig. **19.** *Typical installation of the vacuum lift for the elevation, storage and distribution of liquids.*

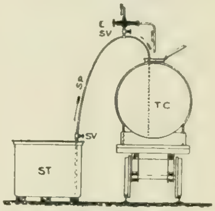


Fig. 20. Steam-jet exhauster used for emptying tank car.

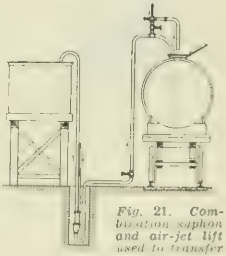


Fig. 21. Combination syphon and air-jet lift used to transfer contents of tank car to elevated storage.

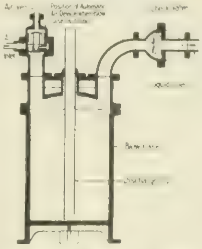


Fig. 22. Diagram of automatic blow-case.

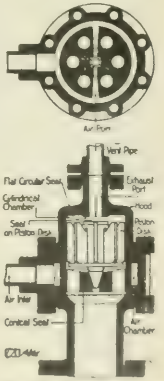


Fig. 23. Plan and elevation of air device.

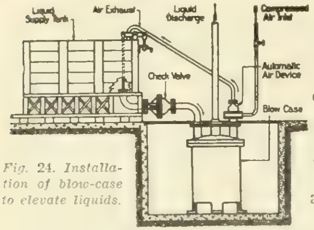


Fig. 24. Installation of blow-case to elevate liquids.

the piston disk is forced tight against the exhaust port, thus preventing the escape of compressed air through the vent pipe. The air also causes the check valve to close and forces the liquid through the discharge pipe of the apparatus. As soon as all the liquid has been discharged, the compressed air remaining in the blow-case expands, its pressure is thereby reduced and the piston disk, no longer held by the compressed air against the vent port, falls and makes contact with the conical seat, shutting off the admission of compressed air. The liquid once again flows into the blow-case and the preceding cycle of operations is repeated.

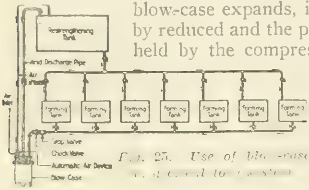


Fig. 25. Use of blow-case [illegible] to [illegible] system

While the blow-case is filling, the air or gas remaining therein after the previous pumping operation is displaced by the incoming liquid and escapes through the surge holes in the base of the automatic air device, thence upward through the spaces between the radial segment on the piston disk, through the exhaust port and out into the vent pipe.

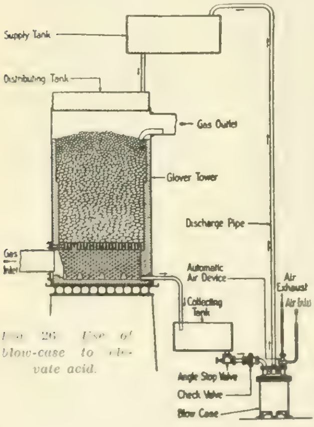


Fig. 26. Use of blow-case to elevate acid.

Typical applications of the blow-case are shown in Figs. 24, 25, 26. 27, and 28. External views of the blow-case alone are shown in Fig. 29; the last two blow-cases shown in the figure are made of stoneware.

Diaphragm Pumps

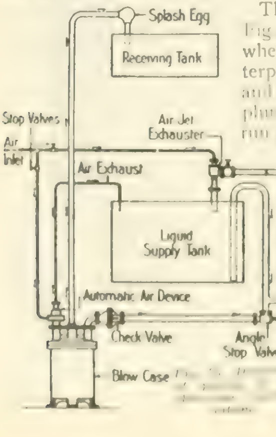


Fig. [illegible]

The diaphragm pump, Fig. 30, is a chemical pump whereby a diaphragm is interposed between the liquid and a mechanically acting plunger. This pump can be run only at moderate speeds, therefore its capacity is limited. It has, however, one important advantage, viz., there are no stuffing-boxes that come in contact with the liquid.

Gear Pumps

Although the gear pump properly cannot be classified as a chemical pumping appliance, inasmuch as it cannot be made of such acid-resisting materials as lead or stoneware, nevertheless it should be mentioned in this article as it is extensively used in the chemical and allied industries for pumping viscous liquids such as crude oil, alkali solutions, tar oils, linseed oil, sizing, soap, molasses, syrup, turpentine, etc. A type of gear pump that excels because of its simplicity and perfect balance of the two rotors is shown in Fig. 31. The driven gear has two rows of holes that are drilled at the roots of teeth 180° apart and that allow oil to enter slots for lubricating the bearing surfaces and for admitting oil under pressure to the center of the driven gear, thus equalizing external and internal pressures and reducing wear to a minimum.

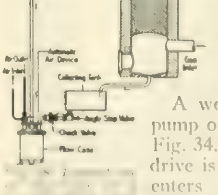
Table IX shows the capacities and pressures against which these pumps ordinarily operate. They can be driven either by a belt or a motor with suitable reduction gears.

Table IX Capacity of Gear Pump, Galls. per Min.

	Size of Pump									
R.P.M.	4	4a	5	6	7	7a	8	9	10	10a
100			7.5	12.5	17	21	26	32	40	47.5
150	5.5	7.5	11	19	25	31	39	48	60	72
200	7.5	10	15	25	34	42	52	64	80	95
250	9	13	19	31	43	53	65	80	100	118
300	11	15	22.5	37.5	51	63	78	96	120	141
350	13	18	26	44	60	73	91	112		
400	15	20	30	50	68	84				
450	17	23	34	56	77					
500	18.5	26	37							
550	20	28								
600	22	31								

Centrifugal Acid Pump

Centrifugal acid pumps are well adapted for handling large quantities of acid, *e.g.*, quantities exceeding 50 galls. per min., but are complicated and inefficient for small capacities. They are either of the horizontal or vertical types. The horizontal pump requires a stuffing box that is difficult to keep tight against the destructive action of acid. For this reason, the vertical pump has been developed. The vertical pump is either submerged entirely in the liquid as shown in Fig. 32, or arranged outside of the tank containing the acid as in Fig. 33. The pump is located always below the low level of the liquid, and the driving mechanism above the high level of the liquid. Under these conditions stuffing boxes for rotary parts are eliminated. Vertical centrifugal pumps do not require any priming and should be used wherever possible instead of the horizontal pump.



A well-constructed lead centrifugal pump of the vertical type is shown in Fig. 34. For this type of pump, motor drive is the most suitable. The liquid enters the center suction inlet and passes into the impeller, whereupon it

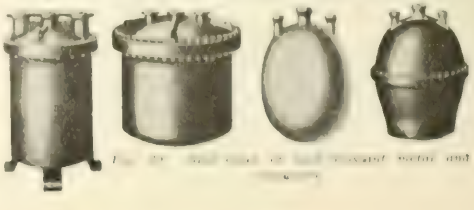


Fig. 29. [illegible] resistant metal and [illegible]

is directed by the vanes to the periphery of the impeller and discharged at the desired velocity. The velocity of the liquid, which is highest at the periphery, is gradually reduced in the volute chamber in such a manner as to convert the velocity head of the liquid into static pressure with a minimum loss of friction.

The casing of the typical pump, shown in Fig. 34, is of the volute design and is made of lead, bronze, monel, regulus metal, or other acid-resisting material in accordance with individual requirements. The clearance between the casing and impeller should be as small as practicable in order to minimize slippage, and at the same time to eliminate any excessive wear that occasionally may be brought about by small particles of gritty substances lodged or ground in between the parts. The shaft of the pump shown is made of steel and is covered with a sleeve made of acid-resisting material. The possibility of the shaft running out of true after being put into service is prevented by the design and arrangement of the pump bearings.

Centrifugal pumps insure steady and continuous operation. They involve minimum outlay for maintenance, upkeep and repairs, and can be built of materials suitable for handling any chemical solution. The capacity of the centrifugal pump ranges generally between 50 and 250 gals. per min., and standard sizes ranging from 1½ in. to 4 in. in diameter meet almost any requirements. Power consumption is small and rate of discharge can be regulated closely by changing the speed of the pump or by throttling the discharge. Even if the discharge is closed, there will be no injurious consequences because of high pressure. Little attendance is necessary.

The centrifugal pump is widely employed in the manufacture of sulphuric acid, both for elevating the acid to the top of towers and also for transferring it from place to place in the plant. Iron pumps are suitable where very strong acid is to be handled, both in contact-process acid plants and in some instances in chamber plants. Lead pumps are generally used for pumping dilute acids.

Uses of Centrifugal Pump

In the manufacture of alkalis, brine ordinarily is pumped from wells into concentrators in which it is brought to the proper density for subsequent treatment. The concentrated solution is then transferred into large cast iron cylinders or towers known as carbonating towers. The centrifugal pump effectively resists the action of alkaline liquors and is for this reason well adapted for this type of plant.

In the manufacture of dyestuffs, intermediates, pigments and similar products, centrifugal pumps are used for transferring the various solutions from one vat to another; in coke-oven by-product recovery plants, for pumping the various distillates and other liquids; in refining naphthalene for handling the acids and alkalis is involved; in the manufacture of phenol for pumping acids, etc. In explosive plants, raw materials such as nitric and sulphuric acids, glycerine, phenol, tuluol, etc., are used. The centrifugal pump resists the destructive action of these liquids, hence its importance for this work cannot be overemphasized.

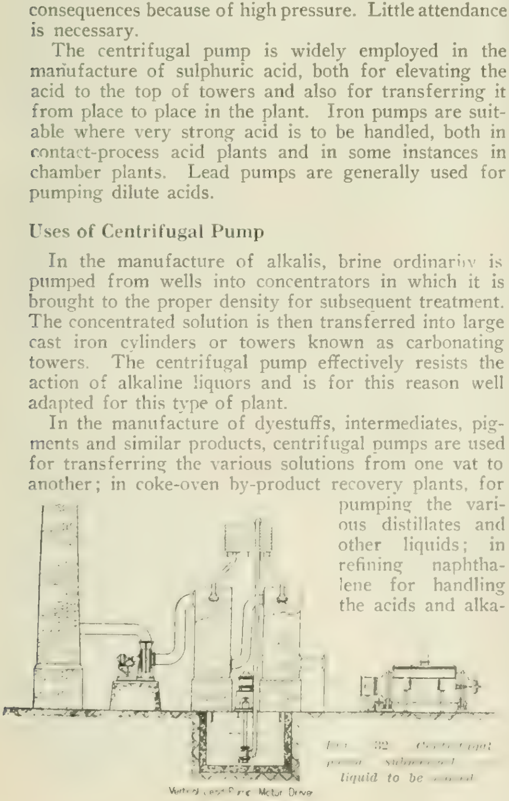


Fig. 32. Centrifugal pump submerged in liquid to be moved

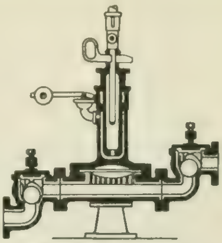


Fig. 30. Diaphragm pump

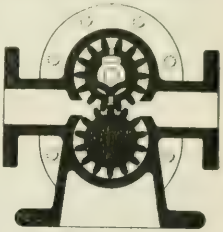


Fig. 31. Gear pump.

The cast iron pump is well adapted for handling large amounts of caustic lye that are required for treating raw oils in cottonseed and other vegetable oil refineries. In paper and pulp plants, it can be installed for pumping bleaching liquor from place to place, for removing the lime from the tanks, for pumping acid liquor to the top of digesters, and for moving the watered pulp.

In metallurgical plants, lead-lined centrifugal pumps can be installed for a great variety of purposes. They are, for example, adapted for handling cyanide and other solutions used for leaching in recovery plants, and in general for pumping acids, alkalis, flotation oils, etc. In petroleum refineries, the lead-lined centrifugal pump is used for handling crude oil, light distillates, naphthalene, paraffin distillates, caustic lye, sulphuric acid, etc., and in the manufacture of candles, etc., for pumping glycerine, liquid soap, lye, oils, waste liquors, etc.

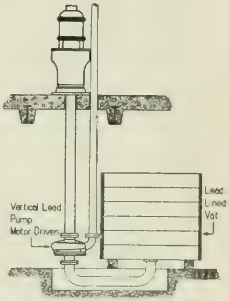
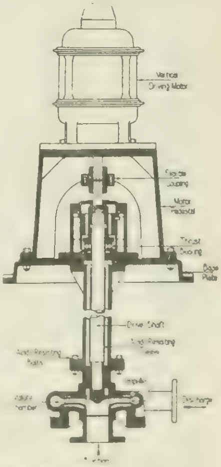


Fig. 33. Installation of centrifugal pump outside of tank.

Hints on the Selection of a Chemical Pump

From the preceding discussion it is seen that a variety of pumps are available for handling chemical solutions. The choice among the several devices depends primarily on the actual conditions under which the pump is to operate.

If live steam is available for pumping purposes, the syphon should first be considered particularly if the liquid is to be heated or if the space for the pump is limited. On the other hand, if the chemical solution must not be diluted or heated, the use of a steam-jet pump is precluded.



[illegible] centrifugal pump of vertical [illegible]

An air-jet lift necessitates an adequate supply of compressed air and the necessary head room in order to secure the submergence required for pumping the liquid to the desired elevation. To provide the proper submergence may in turn necessitate excavation work, which in some plants is prohibitive because of the cost involved.

The vacuum lift is well adapted for handling small capacities, as, for example, in emptying acid drums and for facilitating the distribution of acids on a small scale.

The blow-case is useful in plants where intermittent pumping is satisfactory, where liquor slowly accumulates in tanks and where the liquid is stored at the same time. However, the liquid must be one that is not impaired by contact with the air.

Diaphragm pumps should be installed where only small quantities of liquid are to be moved and where neither syphons nor air-jet lifts can be used.

Gear pumps are recommended for pumping viscous liquids in limited quantities.

Centrifugal pumps made of chemical-resisting materials require a driving motor or pulley drive. Sometimes turbine drive is available. Centrifugal pumps are recommended for capacities exceeding 50 galls. per min.; for small capacities they are inferior to the other methods of pumping chemicals.

No general rules can be given. Each installation involves a number of factors involving nature of process, locality, kind of power available, simplicity, etc. The best procedure to follow is to communicate with those reliable manufacturers who have had extended experience in pumping chemical solutions under all sorts of conditions and to take advantage of their counsel.

Compressed Yeast Manufacture

By Theodore B. Wagner

In the manufacture of compressed bakers' yeast various kinds of grains have been used as raw materials, but on account of the high prices prevailing during the last few years, other raw materials have come to be used, e.g., molasses, as obtained in the manufacture of beet sugar. Such molasses contains considerable amounts of fermentable sugar, nitrogeneous compounds and various plant salts commonly designated as "nutrition salts." The nutrition salts contained in beet molasses, however, are usually not sufficient properly to propagate the yeast and to insure a vigorous fermentation and satisfactory yields. Therefore, it is common practice to add inorganic chemicals, such as ammonia, ammonium phosphate, ammonium sulphate, etc., which also are regarded as "nutrition salts."

I have discovered that the aqueous extract of corn, commonly called "steepwater," obtained in the manufacture of starch, glucose, and maltose, the dried matter of which is called "corn solubles," contains the plant salts in concentrated form, and therefore furnishes ideal nutrition for the yeast. By the use of this material I can discard beet molasses when economically desirable for any substance containing fermentable sugars or sugar producing ingredients, as, e.g., sugar syrups of any kind, as so-called refiners' syrup, cane molasses, glucose syrup, grape sugar syrups, or any syrups obtained as by-products in the manufacture of these syrups and molasses. Starch, or second grade or offal products obtained in the manufacture of starch or other milled cereal products thus become available for yeast manufacture. These latter products require, of course, a previous suitable treatment before fermentation such as "mashing" with malt, or treatment with hydrolyzing or catalyzing agents.

Preparation of Corn Solubles

Corn is steeped in water acidulated with sulphur dioxide, the acidity approximating one-third of 1 per cent calculated as SO_2, at a temperature of about 120° Fah. for about 48 hours, which suffices to extract from the corn practically all the corn solubles, which consist primarily of organic phosphorus salts of the phytin type, potash, calcium and magnesium salts; nitrogenous substances, largely of the amino type; also sugars, gums, lactic and other organic acids.

The constituents of corn solubles are present in steep water in approximately the following amounts:

	Dry basis
Phosphorus as P_2O_5	8.00%
Potash as K_2O	6.00%
Magnesium as MgO	3.00%
Calcium as CaO	1.50%
Nitrogenous matter (Nx6.25)	44.00%

The "steep water" may be used in the fermentation process as employed in the manufacture of compressed bakers' yeast at the specific gravity at which it is withdrawn from the steep tanks, i.e., usually between 4° and 6° Bé., or, it may be used in a concentrated form, obtained by the concentration of the "light" steep water, preferably in vacuo, to about 25° Bé. This is the gravity at which the steep water is usually added to gluten feed, obtained as a by-product in the manufacture of starch, glucose and maltose.

Compressed Yeast Manufacture

In the manufacture of compressed bakers' yeast I prefer to proceed as follows*: To two parts of sugar syrup I add one part of concentrated steep water. I reduce the gravity of the mixture by adding water so that the resultant gravity will correspond to about 15° Balling, and raise the temperature to about 95° C. The character of the steep water as determined by the composition of the corn solubles determines the addition of other nutrition salts; at times I have found it advantageous to add for every 100 gallons of steep water about 50 pounds of ammonium phosphate, and insure suitable acidity, whenever the "mash" is thus deficient by the use of mineral acid.

I then filterpress the mixture and run the filtrate into the fermenters where sufficient water is added to reduce the gravity to about 4° Balling. The temperature maintained is between 25° and 30° C. Care should be taken to maintain a sufficient acidity. Then, I add a "seed" yeast in the required quantity and conduct the fermentation in the usual manner under aeration until end fermentation is attained. Finally, the wort is run through separators and the yeast through coolers to filter presses and put into finished form in the usual manner.

The use of steep water in the manufacture of yeast as above outlined involves the following advantages: Improved keeping qualities of the yeast; an increased yield, and reduced cost of manufacture.

---

* U. S. Pat. No. [illegible] issued November 7, 1922.

Stoneware Equipment for the Chemical Industry

By Percy C. Kingsbury
Chief Engineer, General Ceramics Co.

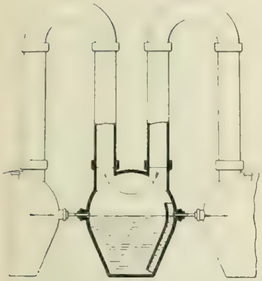


Fig. 1. An example of inefficiency in chemical stoneware construction and installation.

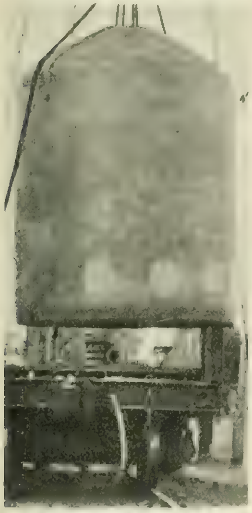
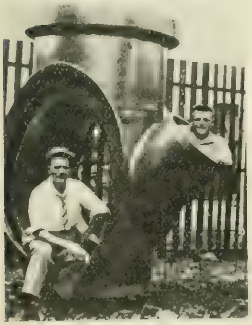


Fig. 2. Stoneware body of an acid egg or blowcase of 1,200 gals. capacity, protected by exterior steel shell. Used for forcing, by compressed air of 50 lbs. pressure, sludge, formed by treating carnotite residues with HCl, into a filter



Fume duct, 18 in. diam., 8 ft. high

CLAY ware molded to the desired shape and fired was the only material available for the first chemical experiments and so may be considered as dating from the beginnings of chemistry. As an industry however the manufacture of stoneware apparatus for chemical purposes is comparatively modern. The first plant devoted entirely to this industry was put into operation in 1836, although prior thereto several manufacturers of other clay products were making various shapes for the chemical industry as a side line, one in Philadelphia having made chemical ware since 1816. Chemical ware has improved steadily in quality and workmanship since then, although some of the ware made in Europe fifty years ago, still in service in this country, compares favorably with much of the material sold today as chemical ware.*

It is only during the past twenty years or so that any serious effort has been made to manufacture anything except the simpler shapes. The chemical engineer of those days was obliged to design his plant to comprise only such shapes as the potter was willing or able to make. This is the reason for some of the inefficient apparatus seen around chemical plants today, an example of which is given in Fig. 1, which shows a vessel for the absorption of hydrochloric acid gas in water. This vessel essentially is a sphere flattened on the bottom, whose purpose is to offer a surface of contact between the gas and the absorbing liquid and to dissipate the heat of absorption by radiation from the exposed surface. The path of the gas through the vessel is extremely short—the gas is not brought down near the surface of the liquid but is free to short circuit across the top of the vessel, the surface of contact between gas and liquid is very small compared with the floor space the vessel occupies. As regards removal of heat of absorption by radiation it is well-known that the sphere is the shape having the smallest surface for a given volume so that in this respect it would be a physical impossibility to devise a more inefficient vessel.

This is only one of many instances that could be cited to show how, to a large extent, the potter decided what kind of chemical ware equipment should go into a chemical plant. The engineer had no choice, as the various other materials developed during recent years with more or less success for handling acids and other corrosive liquids were not available. While chemical stoneware is manufactured in New Jersey, Ohio, Pennsylvania, New York, Massachusetts, Iowa and California, the industry is centered in New Jersey, one plant alone producing about 10 per cent. more than the entire output of Ohio which is the next most important producer. This New Jersey plant, which is the largest plant in the world devoted exclusively to the manufacture of chemical ware, produces as much as all the other plants in the United States put together.

Chemical Stoneware

Chemical stoneware may be considered as a skeleton or framework of more or less refractory particles held together by vitrifying clays. It is obvious that the physical properties of this ware can be modified within comparatively wide limits by variations in the raw

1,000-gallon stoneware vessels for hydrogen peroxide storage; 5′ 6″ dia., 7′ 6″ high, weight 3,000 lbs. each. Cover is ground to an air-tight fit. Here cleanliness and freedom from reducing substances that would affect the free oxygen-content of the peroxide are paramount to resistance to corrosion.

Stoneware pipes 6 in. diam. by 11 ft. long. Although permitting fewer joints, they are difficult to ship, preferable lengths are 4-6 ft. A pipe about 4 in. diam. and 8 ft. 2 in. long with a ⅜ in. wall is used as standard equipment for condensation of nitric acid in the Guttmann plant materials used for this skeleton, in the degree of fineness to which these materials are ground and in the percentage employed in the mixture. At one extreme we have the coarse grained chamotte bodies which are of the nature of firebrick and which are used, e. g., for conveying acid gases at high temperature, as in a salt-cake plant where hydrochloric acid gas leaves the furnace at 400° C. or more. At the other extreme are the fine grained porcelain-like bodies required for the large storage battery tanks used in power plants and for electrolytic cells. An infinite gradation of products is of course possible between these two limits and the selection and preparation of a suitable material to meet some definite purpose requires considerable judgment.

---

*Paper presented before the American Institute of Chemical Engineers, Richmond, Va., Dec. 6, 1922

The clay which forms the vitreous bond between the particles must meet certain very specific requirements. It must vitrify at a definite temperature, i. e., the temperature of the kiln, this being adjusted by mixing it with definite proportions of other fluxing materials. It must be very plastic so that it may be molded into the many different shapes the potter is called upon to make. There must be a considerable difference in temperature between the vitrifying and the fusing points as otherwise the shapes made from it will soften and collapse or at least deform in the kiln. It must have considerable mechanical strength in the green state so as to be able to support its own weight when made up into large and often complicated forms. The shrinkage in drying and firing must be uniform, as otherwise it would be impossible for the potter to work to accurate dimensions; and the clay must be tough so as not to tear apart when subjected to the strain due to shrinking.

As no natural clay will meet all these requirements it is necessary to mix several kinds of clay to secure the desired results. Clays suitable for the highest grade of chemical ware are not widely distributed and for many years we imported about 80 per cent. of our clays from Germany, notwithstanding the fact that our plants are located in one of the greatest clay deposits in the United States.

Preparation of Clay

The various clays are mixed in the desired proportions, washed and screened to remove soluble and other foreign matter. The excess water is then removed by means of filter presses. Other components are then added and the mixture passed several times through a mill in which it is kneaded thoroughly until perfectly homogeneous. The mixture is extruded from the mill in large blocks which are then stored for at least two years in a saturated atmosphere. This has the effect of greatly increasing the plasticity of the clay and for some of our work where great plasticity is necessary, the body is stored for five years. The nature of this so-called ageing action is still a matter of controversy. The popular opinion seems to be that it is bacteriological. It is known that it can be induced and accelerated by the addition of certain organic products, but after some experimental work along these lines we no longer use these ingredients. When the clay bodies are ready for use they are made up into the various desired shapes, due allowance being made for shrinkage.

Molding and Drying the Shapes

Plaster of Paris molds are usually employed for this purpose but many other methods are also used. Thus pipe and other cylindrical and prismatic shapes are extruded, simple shapes are pressed, a few shapes are turned up by hand and others are dry pressed. Where the quantities are large as e. g. in the case of [illegible] rings and Lessing Rings for packing reaction columns and scrubbing towers, eleborate automatic presses are used for this purpose.

After being shaped the ware is dried. The most extraordinary precautions have to be taken at this stage of the manufacture. The shrinkage in drying is quite considerable, varying with the nature and moisture-content of the body from 6-12 per cent. linear. If the rate of drying of any particular shape is not uniform throughout, the uneven shrinkage causes deformation and often also internal stresses, the results of which are not apparent until after the manufacture is complete. To ensure uniform shrinkage at this stage, the drying must be conducted very slowly, or a drier must be used in which the temperature and moisture-content of the atmosphere is under control. Where complicated shapes are to be made or where extreme accuracy in dimensions is desired a drier of this type is indispensable.

Burning the Dry Ware

The dry ware is packed in large kilns which are then bricked up and heated to a temperature of about 1300° C. Just before the maximum temperature is reached common salt is thrown into the fireholes. The salt volatilises and the vapor reaches every part of the kiln. A surface reaction takes place between the salt and the aluminum silicate of the clay body, sodium-aluminum silicate being formed, and dense fumes of hydrochloric acid pass out through the stack. When the maximum temperature is reached the kiln is cooled down very slowly by radiation until the contents can be removed. The time required for firing a kiln depends on its size and to some extent on the nature of the contents. Our largest kilns require three weeks for a cycle, i. e., three days for setting and discharge, four days for heating and thirteen days for cooling. This method of firing periodic kilns is extremely inefficient, practically all the heat being dissipated except a little that is used for drying green ware. For this reason we have installed recently at one of our plants a kiln divided into chambers and furnished with an arrangement of flues so that the heat of the chambers that are cooling is utilised for heating those that are going under fire.

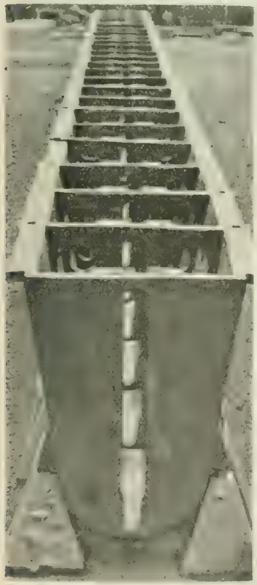
In open kilns the products of combustion come into direct contact with the ware. In this reducing atmosphere the traces of iron in the clay impart a bluish-gray color to the body and a chocolate color to the glaze. In an oxidizing atmosphere the ware would be yellowish with a golden-yellow glaze. White chemical ware which is occasionally required for pharmaceutical and similar purposes requires not only raw materials free from iron and other coloring matter, but the ware must be fired in a muffle kiln as the atmosphere in an open kiln contains volatilised iron which would stain the ware.

After removal from the kiln the ware is tested and sent to the grinding shop if any further finishing is required. The material is quite hard and carborundum is used chiefly for this purpose although less expensive materials also are employed. Many of these manufacturing processes and much of the mechanical equipment used are of course common to most clayworking operations.

Body of Chemical Stoneware

The raw materials used for chemical stoneware manufacture are acid proof within the usual limits for siliceous bodies, and they suffer practically no change in this respect during the various processes. There are, however, many problems of a physical nature met with, the solution of which calls for a high degree of specialized knowledge which can be acquired only in the plant

Stoneware tank 30 in. wide by 11 ft long used in a New York photo engraving shop



Tank [illegible] of manufacture [illegible] for the plain [illegible] by electrodeposition of copper. Note how accurately the slots [illegible]

and laboratory as there is little or no technical literature on this subject. We are concerned here chiefly with the progress that has been made in recent years in adapting this ware to the requirements of chemical industry.

The possibilities as well as the limitations of chemical ware are best shown by a consideration of its chemical and physical properties. A typical analysis of chemical stoneware is as follows:

Composition of Mixture No. 57

	Per Cent.		Per Cent
Sio₂	73.23	MgO	trace
Al_2O_3	22.27	K_2O	2.02
Fe_2O_3	0.58	Na_2O	1.42
CaO	0.58	Loss on ignition	0.06

This ware resists the action of all acids excepting only those which react with the silicia, i. e., hydrofluoric acid and hot and strong phosphoric acid. Concentrated solutions of the caustic alkalies when hot also have some action on this ware. This action however is not considerable and caustic alkalies usually may be handled to advantage in chemical ware. As might be expected a stoneware that is high in alumina resists the action of caustic alkalies much better than one that is high in silica.

Glazing Chemical Stoneware

Chemical stoneware is usually glazed, the glaze being however merely a finish to give a smooth surface to the ware and not for the purpose of adding to the acid-resisting properties. As a matter of fact the glaze is less resistant to chemical action than the body and for this reason there is occasionally demand for unglazed ware. Under these circumstances a very dense body naturally must be used. Some ware is manufactured for chemical purposes having a more or less porous body that depends for its acid-resisting properties on a heavy coating of a prepared glaze applied before firing by means of a brush or spray or by dipping.

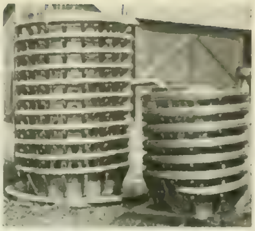
These glazes may be considered as clays with a low melting point which fuse in the kiln to a more or less homogeneous layer at the temperature of vitrification of the body. Such ware hardly can be considered as chemical stoneware as it offers no advantage over the various materials on the market coated with so-called acid-proof paints, varnishes and enamels which become valueless as soon as there is the slightest imperfection in the exposed surface. There can be no question that salt glaze is much to be preferred for chemical work. The percentage composition of this glaze is approximately as follows: SiO_2, 66.80; Al_2O_3, 20.65; Na_2O, 12.55. It is a sodium=aluminum silicate, i. e., a *glass* intermolecularly combined with the body so that it cannot craze nor peel.

Physical Properties

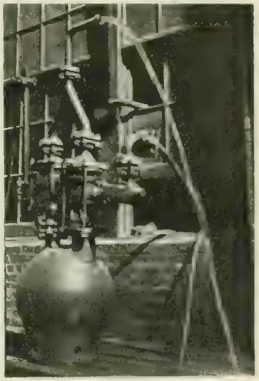
The physical characteristics of chemical stoneware are given in the following table.

Tensile Strength	1,000-2 200 lbs. per sq. in.
Compressive Strength	25,000 lbs. per sq. in.
Modulus of Elasticity	6,000,000-9 000,000 lbs.
Thermal Conductivity (B. T. U.)	0.55-0.6
Specific Heat	0.2
Specific Gravity	2.17
Coefficient of Expansion (linear per C)	0.000003-0.000005

These are of course average values as the physical properties vary considerably with different grades of ware, particularly the tensile strength. Thus the body we use for acid pipelines has a tensile strength of 1000 lbs. per sq. in.; the body used for electrolytic work has a value of 1700 lbs. per sq. in.; the bodies used for pump



Stoneware coils for cooling corrosive liquids; corrugated cross-section of one to right increases cooling surface. Given the right kind of body stoneware coils are not difficult to make and will stand a remarkable amount of rough handling. The most usual size has a 2½-in. tube with a wall 3/16 in. thick and 80 ft. long. It is wound on a stoneware drum, but is not attached to it, so that the tube is free to expand and contract with change in temperature. Used chiefly for condensation of nitric acid.



Stoneware device for automatic transfer of acids by compressed air. Operated by a floating stoneware ball ground to a perfect sphere and fitted to two stoneware seats

[illegible] *Edward Hart, of Lafayette College.*

and exhaust fan impellers and for blowcases are much higher. We have tested an 18-in. impeller to 4500 r.p.m. without bursting it, i. e., a peripheral speed of over 21,000 ft. per minute.

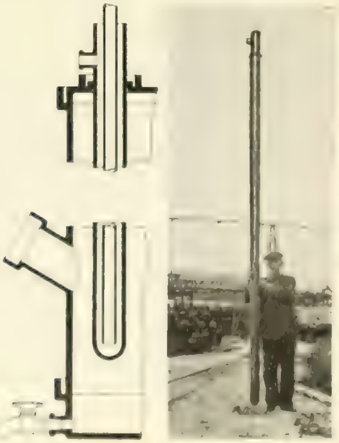
Stoneware exhaust fans of smaller sizes tested to 3,000 r. p. m.

Attempts frequently are made to modify the physical properties of chemical ware by the addition of materials such as carborundum, various refractory oxides, etc. These products are placed on the market from time to time under fancy trade names and extravagant claims are made for them which have seldom been justified. This however opens a fertile field for the future development of the chemical stoneware industry.

Stoneware pumps adapted for innumerable purposes requiring high resistivity or cleanliness.

Shapes and Sizes

Practically any shape that can be made in metal or any other structural material can be duplicated in stoneware if due consideration is given to the physical properties of this ware. In line with the general trend toward large scale production demand has come for equipment in as large units as possible. While there naturally is a limit to the size to which clay ware can be made, remarkably large vessels are practicable; that shown in Fig. 2 is undoubtedly the largest made in this country. Still larger shapes have been made in Europe, a 1500-gallon vessel having been exhibited at a recent exposition in Dresden. The filter presses used in connection with the blowcase, Fig. 2, were the usual wooden plate and frame presses. We now have succeeded in making these filter presses also out of stoneware.


A 4-in. stoneware tube 14 ft. long with one end closed. The open end has a branch near the top with a flange under it as shown in upper part of diagram. Used for cooling H Cl gas from 80° to 15° C as part of apparatus thus shown. A stoneware tower is surmounted by a perforated plate through whose perforations these tubes pass and on which they are supported by means of the flange. Each tube is cooled by water which is carried to the [illegible] and which overflows through the branch at the top.

If stoneware equipment for the chemical plant is to be thoroughly satisfactory it must be carefully erected. An important fact to be born in mind is that although chemical stoneware is undoubtedly the best material for the chemical plant handling corrosive products, yet it is no longer absolutely indispensable except in a few particular cases. No material has the general utility of stoneware but for any specific purpose there is some material that can be substituted for it except in a few special instances. In practically every case these substitutes have no advantage over chemical stoneware; in many cases they have very distinct disadvantages and they are almost invariably much more expensive. Their proposal, however, has served to stimulate the development of the chemical stoneware industry. The production of chemical stoneware in the United States in 1920 increased 54 per cent. over the 1919 production and when the figures for 1922 are available they will undoubtedly show a still further steady increase. This is concrete evidence of the confidence of the chemical industry in American-made chemical stoneware which the manufacturer easily can retain if he will continue to improve his product and will base his sales propaganda on definite demonstrable facts and accurate data rather than no extravagant general statements and so-called "talking points."

Muriatic Acid Plant. Note absence of protection from weather. H Cl gas enters pipe line at about 250° C and reaches first tower at about 80° C

Alfred B. Carhart has resigned as vice president and sales manager, Crosby Steam Gage & Valve Co., to become president and general manager, Precision Instrument Co., Inc., Newark, N. J. Mr. Carhart is a Princeton man, experienced in commercial engineering. Associated with him is L. D. Vorce as vice-president and A. S. Palfrey as secretary-treasurer of the former Precision Instrument Co. The new company will greatly enlarge its activities.

* * *

The centenary of Louis Pasteur's birth, December 27, 1822, was the occasion of a commemoration meeting under the auspices of the Institute of Arts and Sciences at Havemeyer Hall, Columbia University, Monday evening, December 18, at which an address in praise of Pasteur was delivered by Professor Emanuel de Margerie of the University of Strasbourg, French exchange engineering professor. Professor Gary N. Calkins of Columbia and Professor Frederic S. Lee of the College of Physicians and Surgeons also spoke.

III. Copper and Copper Alloys in the Chemical and Allied Industries

By Wilkinson Stark
Chemical Engineer

COPPER forms the basis of a large number of important alloys. As a rule they are more fusible and fluid than copper, give sounder castings, are harder, less malleable, less ductile and more durable.

Originally the term "bronze" (derived from the city of Brundisium, the modern Brindisi, Italy) was used to indicate an alloy of copper and tin only, with a tin content of from 10 to 20 per cent. In more recent times, however, other metals, such as lead, manganese, phosphorus, silicon, nickel, zinc, etc., have been added to the copper and tin to impart to the alloy particular and desirable characteristics. Lead is usually added to give fluidity to the mixture, and thus to produce a casting with sharper lines, such as would be required in sculpture and in the arts generally.

Lead also acts as a resistant to acid corrosion, but is apt to segregate, and therefore cannot be used in excess of 30 per cent. This softening of the alloy by the addition of lead also makes it more liable to erosion. Silicon is added to give hardness to the alloy. It has the disadvantage, however, of adding brittleness, and thus is a drawback from a mechanical point of view.

Manganese plays a double role. It acts not only as a deoxidizer, but gives the copper-tin alloy special mechanical properties. A common composition is copper 88 per cent., tin 10 per cent., manganese 2 per cent. This alloy is ductile, hard and malleable.

Phosphorus has a threefold effect: It reduces oxides and gases, imparts hardness and makes the alloy brittle. The first two are desirable; the last named is objectionable in that it impairs physical properties. Commonsense practice is to use a minimum of phosphorus consistent with the elimination of oxides and gases. Nickel imparts resistance to corrosion.

The alloy sometimes referred to as "gun metal," "gun bronze," or "gear metal," comprising copper 88 per cent., tin 10 per cent., zinc 2 per cent., is substantially a copper-tin alloy which retains all of the properties of a copper-tin mixture. The addition of zinc at the expense of copper is recent practice, and is designed chiefly to promote cleanliness and solidity of metal through its action as a reducing agent. Also in recent times there has been developed an aluminum bronze containing only copper and aluminum, the latter in the proportion of 5 to 10 per cent. It is used largely in making bells, bearings, etc.

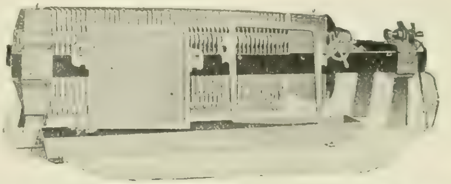
Bronze for Chemical Equipment

In the selection of any metal or alloy to be used in the manufacture of chemical equipment there are four major conditions to be satisfied:

1. The metal or alloy must permit of easy manipulation from the standpoint of good foundry practice. 2. It must have certain chemical and physical characteristics conforming to its intended use. 3. It must machine well. 4. It must be reasonable in price.

Structure of the metal is a very important point to be considered in its resistance to corrosion. Fineness of grain and compactness are essential characteristics of any metal designed to resist the corrosion of chemicals; it is to accomplish this that pressure or centrifugal processes of casting are usually resorted to. Sound, clean castings or forgings are necessary. A blow-hole or porous spot will be attacked first. The denser the casting the stronger front will be presented to corroding influences, and the resistance and durability are to that extent increased. This is the reason why some alloys that appear poor in acid-resisting properties do stand up very well, as, for instance, bronzes which contain zinc, in withstanding the action of sulphuric acid. Hot working of metal always improves grain structure, and for that reason forgings or hot-rolled rods and sheets are better than castings of the same material when they can be used. While all bronzes cannot be thus worked, Resistac, natural nickel alloy, manganese bronze and Hy-ten-sl bronze are readily forged and hot-rolled.

Segregation is a condition to be watched, particularly with high lead content. Lead in a bronze does not really alloy; it is mechanically admixed in minute globules, and in poor bronze castings may be detected with the naked eye. A few of the more popular bronzes and near-bronzes, which are more generally used today, might include phosphor-bronze, manganese-bronze, red brass, Hy-ten-sl bronze, lead phosphor bronze, Ampco metal, Illium metal, Monel metal, Reeves metal, Still metal, etc.

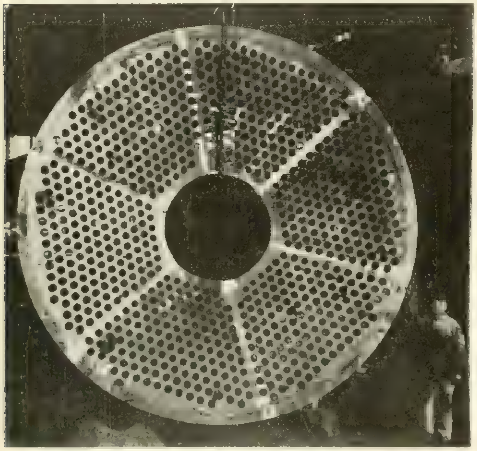


Bronze Filter Press used in filtration of dilute sulphuric acid, copper cyanide, copper sulphate and zinc salt solutions, cane and fruit juices, cereal beverages, alcohols and various food products; of general application where contact with iron of the material treated must be avoided. A good composition is copper 75 per cent., tin 11 per cent., lead 9 per cent., antimony 5 per cent. (T. Shriver & Co., Harrison, N. J.)

The manufacturers of the above alloys, as a rule, do not have one standard formula for all purposes, but for each particular case there is usually a modification of the mixture. Probably the oldest and best known bronze for purposes calling for acid-resistance is phosphor-bronze. However, Ampco and Illium metals are rapidly coming to the front, particularly in connection with their resistance to sulphuric and nitric acids.

Ampco metal is a copper, aluminum, iron alloy with a great preponderance of copper. The No. 18 grade is adapted particularly for acid service, and yet can be machined readily. It has a tensile strength of approximately 85,000 lbs. per sq. in., with an elastic limit of 40,000 lbs. per sq. in. It is especially resistant to sulphuric acid, and shows very little corrosion when used in connection with acetic, citric, oxalic, phosphoric and tartaric acids. It cannot be used, however, in connection with hard lead — commonly called antimony-lead or regulus metal—which is used largely in handling sulphuric acid, as there is an electrochemical action between "Ampco" and hard lead when immersed together in this acid.

Illium metal is applicable particularly for sulphuric and nitric acids. Illium "G" contains chiefly nickel, chromium, and copper, with small quantities of molybdenum, tungsten, silicon, manganese and aluminum. This mixture stands up very well under unusually severe conditions, as, for instance, in contact with sulphuric acid containing copper and ammonium sulphates. Other grades of Illium contain iron to a fair extent in place of molybdenum and silicon.



One of 12 Calandria pan tube sheets supplied to Baltimore plant American Sugar Refining Co. by the American Manganese Bronze Co., Holmesburg, Philadelphia, Pa. Diameter, 12 ft. 6 in.; weight, 7,000 lbs.; tube holes in each sheet, 560; casting, red brass of composition copper 85 per cent., and tin, lead and zinc 5 per cent. each.

There are certain classes of pumping service in connection with handling chemical solutions which are most efficiently dealt with by centrifugal pumps of all-bronze construction. In selecting pumps for handling acids and corrosive liquids generally the first considerations should be durability, accessibility of parts and reliability of action. Efficiency then should be the next consideration if the machine is for constant service and uses considerable power.

The usual services for which bronze pumps have an assured supremacy are in handling brines, sulphites, concentrated sewage, alcohol, wines, fruit juices, dilute sulphurous acid, sugar liquors, acetic acid, mine waters, petroleum products, bitter mineral waters, copper cyanide, cyanogen, glycerin, iron and lime sulphates, glyceride oils, hydrogen sulphide, tannic acid, etc.

In handling sulphurous acid, such as for acid-tower work in sulphite pulp mills, a mixture of bronze made of 90 per cent. copper and 10 per cent. phosphorus-tin seems to give the best performance. This same mixture serves admirably in connection with blow-pits where the digester liquors are diluted and the corrosive action increased. A pump of this alloy, if staunchly built, will perform on acid-tower work, with continuity of operation for periods of seven or eight months without having to be dismantled because of erosion, corrosion, or other causes.

Bronze is used to a very considerable extent in the manufacture of centrifugal extractors. Because of the high stresses set up by the centrifugal force metals of high tensile strength are required, and these usually are supplied in the form of manganese or Hydraulic bronze. The bottom spider and the top rings are the parts supplied as castings. Very clean, uniform castings are necessary. They must be clean because of the acid action present if used in acid work, and uniformity is necessary because of the nice balance necessary in the rapidly rotating parts. Besides these castings the retaining rings of centrifugals are usually made of bronze. These rings go around the outside of the basket, and their function is to absorb the stresses tending to burst the baskets by centrifugal force. Manganese bronze rolled sheet is used for the basket proper, instead of brass or copper, where the material handled has corroding tendencies. Manganese bronze is very largely used for ship propellers, and, in most cases, the propellers outlast the ships.

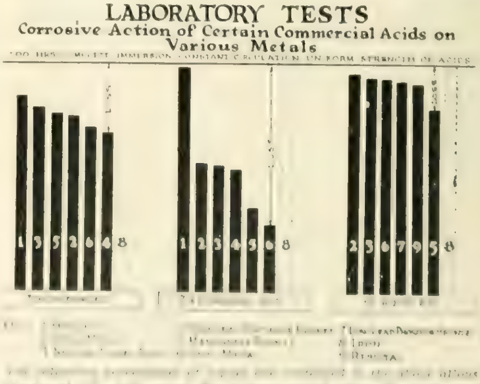
In handling mine water, pumps made of the following alloy seem to have given the best results, to wit: copper 75 per cent., lead 15 per cent., tin 10 per cent. The corrosive agent in this water is free sulphuric acid, and the content varies all the way from 148 parts to 3,000 parts per million.

Interpretation of Laboratory Tests

From considerable laboratory research on the resistance of different metals and alloys to different corrosive agents, and from observing and noting results of actual full-sized installation of the same metals, the following conclusions can be drawn:

1. Results of laboratory tests should be handled with exceeding care when prescribing for actual, full-sized installations because it is impossible to reproduce actual working conditions in the laboratory. Laboratory tests of this kind are at best only a rough guide.

A very good example of the penetration and absorption of an acid solution in a coarse-grained metal, and the care which must be exercised to eliminate, before weighing, any salts or adherent acid, is an example of an acid-resisting metal which was immersed in a solution of sulphuric acid for 500 hours. When the test was completed the sample was removed, washed in distilled water in the usual manner, and weighed. The loss by corrosion was 1.400 per cent. Within 24 hours after this weighing, however, the dry sample showed a slight incrustation of sulphates. It was then placed in a beaker of distilled water, where it remained for 24 hours to remove any remaining salts or acid. The water at the end of this time was distinctly acid, and when the sample was again dried and weighed the loss from the original was 2.003 per cent., the difference after the first test being 0.543 per cent. As this instance demonstrates, great care must be exercised to obtain a clean sample after tests are made, otherwise



[illegible] Pennsylvania, Pa.

the results will be incorrect. It also demonstrates that this sample was of exceedingly coarse structure or, perhaps, was affected by segregation.

2. A metal which may be very satisfactory in resisting one corrosive material may fail completely under a different condition, even with the same material. Furthermore, the test in one case may be made with a fine-grained, dense or fibrous sample; in the other case the sample may be of coarse structure. The results cannot be the same under these varying conditions.

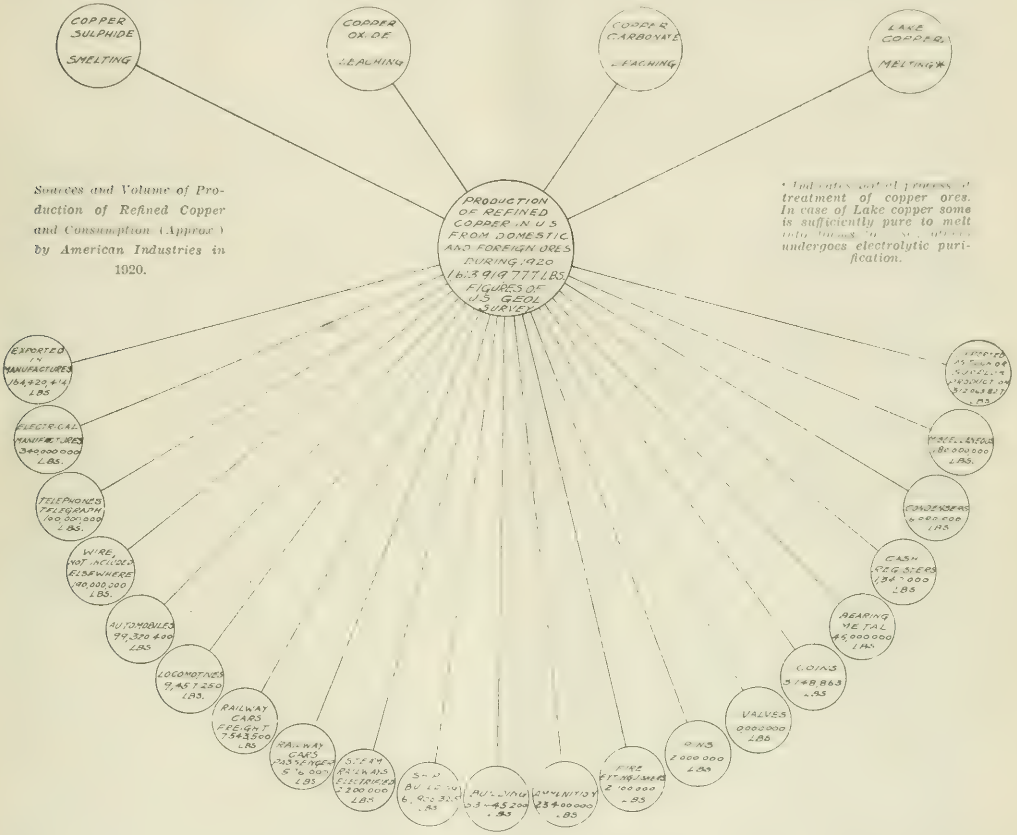
As an example of this two samples of an acid-resisting alloy, of the same weight, designated as A. and B., were obtained, and were so machined that sample A. exposed more of the outside, or fine-grained, part, and sample B. more of the inside, or coarse-grained, part. They were then subjected to a test in running mine-water containing free dilute sulphuric acid, and in which they also were exposed to erosion caused by the suspended solids always present in such waters. The results obtained were as follows:

	A.	B.
Loss in 14 days, per cent	1.78	3.68
Loss in 28 days, per cent	2.35	4.63

The loss from the coarse-grained was approximately twice that from the fine-grained sample. With the above facts in mind it would not be amiss to give an interpretation of the results obtained in a number of laboratory tests, for, after all, they are often the only guide for the selection of a proper material for a specific purpose.

With weak sulphuric acid solutions, not exceeding 3 per cent., at ordinary room temperature, Hy-ten-sl bronze is said to be one of the best resistants. Resistac shows slightly better as to corrosion, but Hy-ten-sl possesses much greater strength and has much better casting qualities. Hy-ten-sl is particularly useful where the difficult combination of acid action and great mechanical wear occurs. Coal-mine screens are a case in point. The mine waters are very destructive to all iron parts because of the weak sulphuric acid present, and the enormous wearing action of the coal sliding over them causes rapid abrasion. Hy-ten-sl bronze, with its great hardness (220 Brinnell and over), harder than any non-ferrous alloy yet produced, gives unusually good service. With the acid content increased to 6 or 7 per cent., the temperature to around 170° F., and excessive aeration introduced, high-lead phosphor bronze gave the best results. An example of this was in the case of large pickling cylinders, for which service this alloy gave better results than pure copper, pure nickel, nichrome, natural nickel alloy, Resistac or Hy-ten-sl bronze.

With weak hydrochloric acid, having 10 parts by weight of commercial strength acid, Hy-ten-sl bronze shows considerably more resistance to the action of the acid than any other bronze or commercial alloy.


COPPER SULPHIDE SMELTING
COPPER OXIDE LEACHING
COPPER CARBONATE LEACHING
LAKE COPPER MELTING*
PRODUCTION OF REFINED COPPER IN U S FROM DOMESTIC AND FOREIGN ORES DURING 1920 1613 919 777 LBS. FIGURES OF U S GEOL SURVEY
EXPORTED IN MANUFACTURES 164,420,414 LBS
ELECTRICAL MANUFACTURES 340,000 000 LBS.
TELEPHONES TELEGRAPH 100,000,000 LBS.
WIRE, NOT INCLUDED ELSEWHERE 190,000,000 LBS.
AUTOMOBILES 99,320 400 LBS
LOCOMOTIVES 9,457 250 LBS.
RAILWAY CARS FREIGHT 7 543 500 LBS
RAILWAY CARS PASSENGER 5 76 000 LBS
STEAM RAILWAYS ELECTRIFIED 5 200 000 LBS
SHIP BUILDING 6,900 325 LBS
BUILDING 53 445 200 LBS
AMMUNITION 23 400 000 LBS
FIRE EXTINGUISHERS 2 100 000 LBS
2 000 000 LBS
VALVES 0 000 000 LBS
COINS 3 148,863 LBS
BEARING METAL 45,000 000 LBS
CASH REGISTERS 1,34 000 LBS
CONDENSERS 6 000 000 LBS
MISCELLANEOUS 180 000 000 LBS.
312 063 827 LBS

Sources and Volume of Production of Refined Copper and Consumption (Approx.) by American Industries in 1920.

* *Indicates [illegible] process of treatment of copper ores. In case of Lake copper some is sufficiently pure to melt [illegible] undergoes electrolytic purification.*

With weak sulphurous acid, of 6 per cent. strength, the results, as compared with sulphuric acid, are somewhat reversed. Still metal, a bronze high in tin, seems to give the best results, although high-lead phosphor bronze and gun metal are good.

With acetic acid at 5 per cent. strength, Still metal is the best resistant. It is used largely in making acetic acid stills. For handling malic acid and citric acid Resistac bronze, in the form of an autoclave, stood up when a great many other metals failed. This bronze is high in aluminum.

To enumerate all the articles that copper is used for or forms a part of is impossible in limited space. Almost everywhere at hand, and in thousands of various utensils, can be found copper, brass or bronze. However, some important individual uses can be given.

Uses of Copper

Automobile: Radiators, gasoline tanks.

Building: Conductor heads and pipes, cornices, eaves troughs, doors, flashings, fronts, gutters, panels, roofs, shingles, skylight frames, tiles, trims exterior and interior, valleys, ventilators, window frames and sash.

Chemical Equipment: Autoclaves, condensers, digesters, evaporators, extractors, stills, retorts, dryers, flasks, beakers, incubators, receiving eggs, pre-heaters, varnish kettles, vacuum pans, baskets for centrifugals, etc.

Dairy Equipment: Condensers, freezers, pasteurizing machine, separators, vats for pasteurizing and storage.

Electrical: Anodes, electroplaters' and electrotypers' bus bars, cable ends and connectors, flat conductors, heat reflectors, knife switches, laminated flexible conductors, motor brushes, renewable fuse parts, etc.

Kettles: Candy, chocolate, glue, paint, preserving, soup, varnish, etc.

Laundry Equipment: Wash-boards, wash-boilers, washing machine linings, washing machine tubs.

Miscellaneous: Ornamental drawn, hammered, spun and stamped articles, fire extinguishers, fire pails, fire pail storage tanks, kettle drums, mail boxes rural, nails, nuts, etchers' and engravers' plates, railway car basins, railway car roofs, soda fountain sinks and cans, statuary, store signs, show cases, table tops, tacks, washers for butts and rivets.

Range and Stove: Boilers, reservoirs, reflectors.

Refrigerators: Linings, tanks.

Steam and Water: Boilers, boiler fire boxes, boiler tubes (small), boiler tube ferrules, condenser tubes (special closed end), floats, flush-tank linings, gaskets, heaters, pipes (brazed joint), sterilizers, thermostats.

Utensils: Kitchen, restaurant and ships' galleys boilers (ham), chafing dishes, cookers (fireless), funnels, kettles for preserving, ladles, measures, moulds, pails, baking pans, percolators, pots, roasters, skillets, spiders, strainers, tubs.

Copper wire is used almost entirely for electrical purposes. Copper tubing is used in large quantities for marine fittings, piping, etc.

Uses of Brass and Bronze

Adding and calculating machines, automobiles, bells and gongs, bicycles, brass bedsteads, candlesticks and candelabra, cash registers, cheap jewelry, clocks, condenser tubes for marine work, dental instruments, desk accessories, dictaphones, draftsmen's instruments, electric fans and fixtures, emblems, novelties, engine and fire room fixtures, filter presses, firearms, fire extinguishers, jewelers' instruments, lanterns, flashlights, lighting fixtures, standard and table lamps, locks and other hardware, medals, metal badges, buttons, motorcycles, motor trucks, musical instruments, nautical instruments, office fixtures, optical goods, opticians' instruments, organs, phonographs, pianos, picture frames, plumbing supplies and fixtures of all kinds, pumps of all kinds, railings, refrigerators, scales, signs, ship propellers, soda fountains, souvenirs, store fixtures, surgical instruments, surveyors' instruments, trophies, typewriters, valves, watchmakers' instruments, wire screens, etc.

Pulverulent Shortening Agent

Shortening is defined by Washington Platt as any fat or fixed oil used as an ingredient of baked products. It brings about its effects by extending throughout the dough or cake in layers which separate the particles of the dough or cake from one another and prevents the formation of a continuous solid mass, in other words, sogginess.

The industry of prepared flours in package form recently has been extended to embrace the combined ingredients for the more delicate products of baking, which require shortening. The manufacture of a pulverulent shortening, therefore, has become an important part of this branch of applied chemistry.

The manufacture of this commodity is an example of the innumerable ways in which the work of the chemist contributes to human convenience, comfort, efficiency.

By combining the edible fat or oil with flour, a pulverulent mass can be obtained which admits of sifting and ready incorporation in preparatory products designed to lessen the demands upon the cook in the preparation of numerous foods. Henry V. Dunham, Mt. Vernon, N. Y., mixed flour of any of the commercial grades with 10 parts of water and boiled the mass to a paste after which the oil was emulsified with it. The mixture then was homogenized and dried. Two parts of cocoanut oil were used to 1 part of flour, the former being added to the liquid at about 100° C. Mr. Dunham met with unsatisfactory results in some uses, because the amount of water which the cooked flour will take up differs from that taken up by uncooked flour, whereby the product imparted sogginess to the cake or pastry in which it was used.

Mr. Dunham found* that this objectionable feature could be overcome by reducing the flour to a liquid form at a temperature too low to permit the conversion of starch granules into starch paste. He reduced the starchy material with cold water to a non-lumping mixture and added additional water to bring the proportions to about 5 parts of water to one of flour. Addition of cocoanut oil in equal parts with flour was found to yield the best results. The flour mixture and oil are emulsified, passed through a homogenizer and dried at a low temperature by spraying into a vacuum chamber. Low temperature is essential to prevent hydrolysis of the starch.

The product thus obtained is a pulverulent mixture somewhat resembling flour in appearance. The product can be added to flour by sifting in making up cake, pastry, bread, biscuits, etc. Spraying liquid fat into dry flour has been proposed, but by this process, incorporation of only about 10-15 per cent of oil is possible, larger amounts yielding a product too greasy to permit ready sifting and uniform mixing with flour. Mr. Dunham claims for his product the absence of this objectionable feature even when the quantity of the oil is in excess of the quantity of flour used.

*U. S. Pat. No. [illegible]

Current Chemical Patents and Patent Problems

By Lloyd Van Doren, Ph.D.
Consulting Chemist; Patent Attorney, Duell, Warfield & Duell

With reference to securing the assistance of an attorney in the prosecution of an application for patent, the Rules of Practice of the United States Patent Office, in Rule 17, state:

> An applicant or an assignee of the entire interest may prosecute his own case, but he is advised, unless familiar with such matters, to employ a competent patent attorney, as the value of patents depends largely upon the skillful preparation of the specification and claims.

However, the Patent Office does not and will not aid in the selection of an attorney. A register of attorneys is maintained at the Patent Office in which is entered the names of all persons who are entitled to represent applicants before the Patent Office in the presentation and prosecution of applications for patent. This register is open to the inspection of any who may so desire.

The selection of an attorney may be said to be the most important procedure in connection with the securement of a patent, for, as the rule above cited has stated plainly, the value of the patent depends largely upon proper preparation. Therefore, an inventor or an assignee of the entire interest in an invention should exercise diligent care in making this selection, *i.e.,* the reputation and the particular fitness of the attorney under consideration for the particular work in hand should be most cautiously considered prior to placing the case in the hands of the attorney. It is the duty of an attorney to give his best efforts and to work conscientiously in behalf of the client without allowing the idea of remuneration to be predominant. It is regretted that sometimes this ideal is not accomplished, as is well shown in a recent incident happening in the offices of the Federated Engineers Development Corporation in Jersey City, which will serve as an example of an attorney working purely for the sake of a fee, and not to the best interests of his client.

A man of the typical inventor type, shabbily dressed, with a bulky bundle under his arm wrapped in a newspaper, came to the offices and asked, "Is this where you look at patents?" Upon being assured that he was in the right office, he made his way to a seat beside the manager's desk.

"I have invented a patent," he said as he drew himself up proudly. "Indeed!" was the only reply that could be summoned to this astonishing statement.

Then the inventor proceeded to proclaim the value of his invention. When asked to see the patent, he looked about suspiciously and wanted to know what protection he had. He was informed that a patent was a public disclosure of an invention and if he had a patent, there was no need for further secrecy, but apparently it was impossible for him to get out of his head the notion that his invention was a patent. Finally, he admitted that he had received some papers from the Government, and would show them.

In the meantime, however, he tried to impress the importance of his invention. It pertained to automobiles and motor cars, and this gave the inventor a chance to point out the millions of cars in service, the fact that each car had four wheels, which quadrupled his millions, and that each wheel should carry four of his devices, which still further multiplied the millions. He conservatively estimated that at least half of the machines would employ his device and then began to draw on the millions of dollars which would flow into his coffers. It was with difficulty that he was brought down to earth long enough to show his patent and find out what he was talking about.

The invention proved to be a cleat which could be attached to automobile wheels, the purpose of which apparently was to replace chains in wet weather. There was nothing remarkable about the form of the cleats or the means of attaching them to the wheel. It was evident at a glance that the invention was not one which could possibly interest the Corporation. Nevertheless, the patent drawing showed a conspicuous blank space in the upper left hand corner of the sheet which aroused suspicion, and they proceeded to draw him out further.

The claim—he had only one claim—was almost half a column in length and described in infinite detail the cleat which was shown in the drawing. It was explained to him that in general the shorter the claim, the broader it is and the more it covers, while the longer a claim, the more specific it is and the more narrow; that his patent merely covered a slight improvement over other cleats, and that if a general demand for cleats should arise, there would be a thousand and one ways of getting around his patent without the least infringement. He assured them that his construction was the very best possible and that his lawyer had told him that no one could make anything like it; thereupon, he unwrapped the paper bundle and showed his model. As suspected, the model did not exactly conform to the drawing or to the claim, and he was shown where he himself had in his model demonstrated a means of getting around his own patent without infringing it.

Then the inventor became confidential. He began to suspect his own patent attorney.

"I never did quite trust that fellow," he said. "There was something funny about the way he treated me. First he made a drawing just like this model and next time I came in, he put in another figure. I told him that was not my invention, but he said it would have to go in to get the patent papers."

He drew a paper from his pocket which proved to be a blueprint of the original patent drawing, disclosing a figure in the space which was blank in the patent copy.

"After the papers were sent to the Patent Office," he explained, "they made him take out the first two figures, but the lawyer said it was all right and nobody could make anything like my invention anyway."

The situation was then very clear. The attorney after making a preliminary search had found nothing patentable in the original construction, and had then deliberately introduced a modification on which he could hinge a claim. As a matter of fact, the patent was invalid, because it was issued in the name of the visitor and he was not actually the inventor of the construction defined in the claim. He had spent his time and money and built up great hopes on a patent which was of no more value than a piece of paper. He was right when he stated that a patent had been "invented," but it was his unscrupulous attorney who had "invented" the patent in order to collect his fee.

Buttons from Gypsum

In the production of buttons from a cheap raw material, which can be found in nearly any country, and to obviate thereby the importation of horn, ivory-nut, etc., of which materials buttons are mostly made, the material to be formed or shaped, for instance calcined gypsum, is pressed in dry condition into a mold and the pressed and shaped form-piece is then lifted out of the mold, whereupon it is caused to set by moistening it with water suitably sprayed. In this manner it is possible to produce from calcined gypsum, cement or similar materials, buttons with greater exactness and speed of operation than by producing these form-pieces from a pulpy mass of calcined gypsum or cement or some other plastic material. A pulp of calcined gypsum which is wetted with only a slight quantity of water, can be molded only with difficulty as it will set too quickly; if more water is added, the pulp can be better shaped or molded, but the structure of the form-piece would be very incoherent and could not serve as material for making buttons, as it will crumble to pieces very easily. Furthermore the form-piece can be lifted from the mold only after the setting has taken place.

Arthur Haenicke, of Berlin-Tempelhof, Germany, has found, U. S. Pat. No. 1,427,103, that the dry and finely ground material can be pressed into any desired shape and still dry be lifted immediately out of the mold. Only after the shaping or molding of the material does the setting take place. If for this purpose the form-pieces were submerged into water, they would immediately fall to pieces, as the material will absorb too much water, while when applying the moisture to the form-pieces by means of a brush the surface could be easily injured. For these reasons, the liquid used to effect the setting is sprayed upon the form-pieces, which eagerly absorb this liquid spray, and are exposed to it until they have absorbed just that quantity of moisture necessary for the setting of the material. By this method form-pieces of such a rigidity are produced that they can be used very successfully as buttons after the usual treatment. Instead of calcined gypsum cement or burnt magnesite or also a mixture of these materials can be employed advantageously. If burnt magnesite is used, the setting of the mass must be effected by means of a solution of chloride of magnesium whereby occurs the formation of Sorel cement.

* * *

Vulcanized Plastic Coating

H. E. Brown, Kingston, N. Y., and J. H. Stover, Nutley, N. J., have found a combination of cellulose xanthate with india rubber to possess virtues as a plastic binding and water proofing material that reside in the properties of a new composition of matter. They have found that when cellulose xanthate and caoutchouc or gutta percha in suitable solution are brought into intimate contact, a reaction ensues whereby a homogeneous product is obtained, whose subsequent vulcanization on application of heat is effected by the sulphur supplied by the xanthate.

A solution of cellulose xanthate, prepared by treating alkali cellulose with carbon bisulphide and dissolving in water, containing, *e.g.*, 6.5 per cent of cellulose, is mixed with vigorous agitation with india rubber solution (1 part caoutchouc to 20 parts benzol), in the proportions of 1:10, this proportion providing the most satisfactory measure of elasticity. Other elements being the same, a larger proportion of sulphur results in a denser material while a smaller proportion yileds a softer and more flexible product. Addition of glycerine (6.5 per cent of weight of cellulose) imparts flexibility and durability.

The product, U. S. Pat. No. 1,431,455, has been found especially valuable as a binding and filling material in the manufacture of woven and non-woven fabrics as imitation leather, wall coverings, linoleum-like materials for floor coverings, table coverings, clothing, fabrics, sails, tarpaulins, etc.

Not only raw india rubber, but also reclaimed rubber may be used, even that containing large quantities of tar compounds, such as is used for wire insulation. The binder itself may be modified by adding various mineral and non-mineral fillers and organic compounds or various oils, such as linseed oil, castor oil, etc. The inorganic fillers available are magnesium oxide, carbon black, red lead, ferric oxide and zinc oxide. These fillers give body to the binder and to the resulting fabric with which it may be combined, and also impart color. Organic fillers embrace gum arabic, glue, sugars, phenols and creosote [illegible] in-creased pliability, and the use of sugars, phenols and creosote tars, tends to prevent dehydration of the rubber. All these substances may be used separately or in combination, according [illegible]

Recovery of NO_2 from Dilute Nitrous Vapors

[illegible]

Improved Procedure of Reduction

In many commercial chemical processes it is necessary to reduce some compound. This reduction may be simply the removal of oxygen, or it may be the addition of hydrogen, or both the removal of oxygen and the addition of hydrogen as the case may be. These reductions are usually carried out by treating the substance with active or nascent hydrogen formed by the action of acids on zinc or iron, or by the action of alkalis on zinc, or alcohols on metallic sodium. Reductions usually have been made in suitable tanks by adding iron filings to a nitro-compound in acid solution, or zinc in alkaline solution. This, however, requires a very large excess (about 500-600 per cent of the reducing agent), and as a result, the reducing solutions have been polluted with iron salts, or zinc salts as the case may be, which have to be eliminated before the amino compound can be used.

By effecting reduction in a centrifuge, W. O. Mitscherling, Atlas Powder Co., Wilmington, Del., avoids the use of excessive quantities of iron or zinc, he finding it possible in continuous reduction to use only 50 per cent more than theory of iron or zinc to perform a reaction. The apparatus used embraces, beside the centrifuge, a tank containing the material to be reduced, *e.g.*, nitro-benzol or naphthalene-nitrotrisulphonic acid, and a tank containing the reducing agent, *e.g.*, zinc dust or iron filings suspended in water. In carrying out the process, U. S. Pat. No. 1,432,775, Mr. Mitscherling allows the reducing agent to flow into the centrifuge where the metal, either iron or zinc, is deposited in sufficient amount upon the inner wall of the rotor, after which the acid or alkaline solution to be reduced is fed continuously into it. Thus, *e.g.*, if an acid solution of the organic nitrates to be reduced is fed through the bowl of the centrifuge, the acid attacks the zinc on the walls thereof, liberating hydrogen which in turn, reduces the nitrate to the amino compound which is discharged in acid solution. As the metal is consumed, it may be replaced readily by opening the valve on the line to the tank containing the reducing agent.

The procedure of reduction thus outlined yields clarified solutions of the amino compound as the sediment collects on the walls where it may be removed readily. Inasmuch as the centrifugal force creates a pressure of about 400 lbs. per square inch, the loss of hydrogen common to reduction processes carried out in open kettles is avoided, consequently effecting a saving not only in amount of metal needed, but in reduction of the amount necessary to be removed from the solution by subsequent treatment.

Gum Dammar as an Emulsifying Agent

Emulsions can be classed in two general groups, to-wit, the "oil-in-water" type and the "water-in-oil" type. In the first type drops of "oil" are distributed throughout a more or less continuous body or mass of "water" and in the second, drops of "water" are distributed throughout a more or less continuous body or mass of "oil." Emulsifying agents for the "water-in-oil" type of emulsion have usually been calcium, magnesium and aluminum soaps, other heavy metallic soaps, lamp black, or wool fat (lanolin). Even with such emulsions the emulsion is not permanent and finally breaks, the drops of the "water" or watery material finally running together, so that the two liquids form two layers.

Both types of emulsion are produced by the use of an emulsifying agent, a substance or mixture of substances usually of a colloidal nature, which must be more or less soluble in or wetted by the surrounding body liquid.

Harry N. Holmes and Donald H. Cameron, of Oberlin, Ohio, have found that more stable emulsions of the "water-in-oil" type may be produced by the use of proper solutions or suspensions of gum dammar, as an emulsifying agent. Gum dammar, functions after the manner of a colloid, or at least has colloidal properties. Only relatively dilute solutions or suspensions of this gum are necessary, say approximately 1-5 per cent. Moreover, this varnish gum can serve as an effective emulsifying agent in a great many, if not in all, of the various "water-in-oil" emulsions. It, of course, is effective in every instance where it can be brought into solution with or is wetted by the "oily" agent. In these emulsions of the "water-in-oil" type, the watery material of the drops can be water or glycerine and in certain cases glycol, or any of their mixtures or solu- [illegible] The only [illegible] toluene, carbon tetrachloride, carbon disulfide, ether, petroleum [illegible]

[illegible]

tity of water or glycerin therewith and agitating the mixture. The effect of agitation is to break up the watery material into finer and finer drops according to the degree of shaking. Around each drop there appears to be formed a tangible film or skin of semi-solid form, elastic and quite flexible. This film or skin appears to be distinctive of this improved emulsion and has been definitely noted as a tangible thing, in many cases easily visible around large drops, in which it differs from prior emulsions. The skin is tangible because it quickly forms about a single large drop of water placed in a benzene solution of gum dammar and can be removed from the drop and inspected. The precise action is difficult to ascertain, but it is probable that the gum in the benzene has become more concentrated at the surface of each drop. This skin or film is so persistent that for a considerable time it prevents the drops of water or watery material from running together. An attempt to break the film merely causes it to heal over and create two or more drops where there was one before. In the production of the emulsion, the average drop size may be controlled by the relative proportions of all materials used, the temperature of the mixture and the process of homogenization. Emulsification can be accomplished by violent shaking, grinding, stirring, or by throwing the mixture against baffles or other perforated walls.

Gum dammar as the emulsifying agent is capable of use in many ways, some examples of which follow: In the manufacture of pharmaceutical preparations petroleum jelly may be made to include and carry drops of water, glycerin, watery solutions of solids or liquids, or watery pastes, any or all of which may carry medicinal or antiseptic material. In the manufacture of inks, carbon black or varnish inks may be diluted with drops of water or watery materials to give a suitable or desirable body, thus lessening the cost of the product without necessarily interfering with the quality of the inks. The lithographic inks, which are composed of pigment in an oil vehicle may also be diluted with water or watery materials by this process of emulsification. Cleaning compounds may also be produced by mixtures of organic grease solvents and aqueous cleaning or bleaching compounds. Paints consisting of pigment in oil or organic solvents may have a desirable amount of water or watery material emulsified therewith in a stable form.

One of the most important uses is in color photography. In this case, a color screen may be readily formed by a cheap and simple process. As an example, a water soluble dye may be added to a gelatin water solution and this solution while in the liquid state may be emulsified in a benzene (benzol) gum dammar solution or suspension. Petroleum distillates, ether, carbon disulphide, chloroform, turpentine, toluene, carbon tetrachloride or any other organic liquid or mixtures of organic liquids which will dissolve the emulsifying agent, gum dammar (and will not dissolve in the watery material), may be used as a substitute for benzene (benzol). The mixture is violently agitated to reduce the size of the gelatine-water drops containing dye to as small a size as is desirable. By making up two, three or more different emulsions each one carrying drops of gelatin-water dyed a color different from that of the other emulsions used, it is possible to mix these vari-colored emulsions so as to obtain one emulsion carrying drops of the several different colors. The emulsion thus formed is coated upon a suitable support such as a glass plate, film or the like.

As stated, the effect of the gum dammar as an emulsifying agent is to form a tangible film or skin around each separate drop. When the emulsion is coated upon glass or film the benzene evaporates, leaving the separate drops lying upon the plate each coated with a film or skin containing the gum dammar. This is a varnish gum which now serves for a new purpose, to-wit, as a cement or glue to stick the drop to the plate or support. The skin or film also prevents any tendency for the drops to bleed or run together, but each little mass of colored gelatine water solution is held separate from all the others. The water in the gelatin water drop slowly evaporates leaving upon the support dyed gelatin particles cemented to the plate by dammar varnish. This mosaic plate or screen may be used in the same way as other screens in color photography. The screen may be coated with photographic emulsion and used in a manner similar to the autochrome plate. Each colored particle may also carry sensitive silver salts or other light sensitive material and thus become a miniature plate incorporated with a monochromatic color screen. The dyed particles may also be rendered insoluble in water by treatment with formaldehyde or other substance which will render the gelatin insoluble in water.

Purifying Naphthalene

In the common procedure of purifying naphthalene the crude material, with its oily impurities, is run into shallow trays where it is allowed to crystallize slowly. Separation of the impurities is effected by centrifuging or hydraulic pressing the mass of crystals. David F. Gould, of the Barrett Co., has found that fractional crystallization may be effected more economically by running the crude naphthalene into an agitating tank at a temperature of about 85° C with an equal volume of water at about the same temperature. The mixture is vigorously agitated until an intimate mixture is obtained; cold water is run in, with slow agitation of the mass, at such a rate that the temperature slowly drops to about 65° C. during a period of about eight hours. The slurry resulting is pumped to centrifugals where the water and oily impurities which have separated from the naphthalene are removed as completely as possible, or the water may be drained off first and the impurities then removed independently. This procedure has been found to produce crystalline scales of naphthalene of uniform size of the same shape and structure consisting of several individual thin crystals of naphthalene laminated one upon the other.

Non-Fuming Phosphorus

In the preparation and use of compositions containing phosphorus in manufacturing matches, pyrotechnical devices and similar products, phosphorus on exposure to the air undergoes oxidation with the evolution of fumes injurious to the worker. Sam. S. Sadtler, Phila., Pa., has found that by admixture with the phosphorus of certain organic bases of high-boiling point as a-naphthylamine and dimethylaniline, they not only neutralize the fumes of phosphoric oxide, but protect the phosphorus against too ready oxidation. Mr. Sadtler prepares the non-fuming phosphorus composition by first melting the phosphorus to which a small quantity of sulphur may be added to maintain it in the liquid state, whereupon the liquid organic bases mentioned, are added and stirred in. The proportions are as follows: phosphorus, 32 parts; sulphur, 5 parts; a-naphthylamine, 2 parts; dimethylaniline, 4 parts. The resulting mixture can be preserved without any development of white fumes, or so called phosphorus odor, such fumes being absorbed as soon as formed by the a-naphthylamine and the dimethylaniline. It may be used by itself or in admixture with chlorate of potash and the other ingredients usually employed for match-making compositions and certain types of pyrotechnical devices.

Colloidal Sulphur

Sulphur can be obtained in a state of extremely fine division or in a highly dispersed or colloidal condition, by evaporating solutions of ammonium polysulfid containing a protective colloid, until the ammonia and hydrogen sulfide are practically removed. Protective colloids of various kinds may be used or waste materials containing them, *e.g.*, saponines, gelatine, casein, sodium lysalbinate, waste sulfite liquor, naphthol pitch, glycerine foots, etc., Evaporation may be effected under ordinary or diminished pressure, and by means of passing inert gases through the solutions, if desired. A very finely divided, white sulphur capable of forming extremely stable suspensions, or sols, thus may be obtained. Moreover, the properties of the sulphur so obtained can further be influenced and graduated by the nature of the protective colloid employed and its quantity. The sulphur can be separated from the liquid by adding an electrolyte, or by a current of air blown through the solution. In the case of concentrated solutions, a portion of the sulphur settles after a time as a white creamy deposit. From such deposits the sulphur can be retransformed easily into a very stable sol by simply stirring with water.

A. Mittasch and Fritz Winkler, of the Badische Anilin-& Soda-Fabrik, carry out the process, U. S. Pat. No. 1,429,522, by running slowly a concentrated solution of ammonium polysulfide into a boiling aqueous solution of soap of 0.5 per cent strength, contained in an aluminum or enameled vessel, so that the ammonia and hydrogen sulfide are continuously boiled away. A thick milk of sulphur is produced which is first yellowish-white but becomes pure white as soon as the ammonia and hydrogen sulfide are completely removed. If a test portion of this milky liquid be diluted with a large quantity of water, about 1,000 or 10,000 times as much, a highly dispersed, bluish sol is obtained, the particles of which are of a size of 0.001 millimetres and even less.

Instead of soap as a protective colloid a 5 per cent solu. of evaporated neutral waste sulphite lye can be used which may be oxidized with hypochlorite. From the milk of sulphur so obtained, the sulphur separates on standing in the form of extremely small threads or needles, giving a deposit of a brownish color owing to the impurities of the sulfite liquor. This deposit can be filtered off, washed and brought into a paste or dried. It can be transformed again into a milk of sulphur or into a sol by agitation with water, without any further addition of protective colloids.

Owing to its extremely fine division, the sulphur thus obtained can be used for pharmaceutical purposes as well as for curing plant diseases. For practical purposes it often may be advantageous to bring the sulphur into a paste or powder and to retransform it as needed into a suspension or colloidal solution.

Synthetic Apple Oil

Frederick B. Power and Victor K. Chesnut, Bureau of Chemistry, United States Department of Agriculture, have found that the odorous constituents of the apple include in addition to the combination of the amyl esters of formic, acetic, caproic, and caprylic acids, together with acetaldehyde, also a very small amount of the aliphatic terpene alcohol, geraniol, $C_{10}H_{18}O$. This substance may be considered to exist both in the free state and in the form of its esters, and it imparts to the apple a distinctive fragrance. Although contained in very small proportion in the most fragrant varieties of the fruit, it is believed to be a constituent of all apples. Geraniol or its esters has been found to modify to a considerable degree the odor of their synthetic apple oil and to enhance materially its fragrance, thus enabling them to reproduce more truly and completely the natural odor of the choicest apples.

These chemists have now prepared a new synthetic apple oil which has the following composition by volume:

	Parts
Iso-amyl ester of formic acid	10
Iso-amyl ester of acetic acid	10
Iso-amyl ester of normal caproic acid	5
Iso-amyl ester of normal caprylic acid	1
Acetaldehyde	2
Geraniol	1
Geranyl ester of formic acid	1
Geranyl ester of acetic acid	1

This combination may be used for flavoring purposes either in its concentrated state or in the form of a solution in pure ethyl alcohol, in a mixture of alcohol and glycerin, and with alcohol solutions of certain organic acids such as citric and tartaric acids, or it may be brought into the form of an emulsion with certain fatty oils, especially such as have the least tendency to become rancid on keeping.

Calcium Arsenate

In the manufacture of calcium arsenate $Ca_3(AsO_4)_2$ by the reaction of arsenic acid upon calcium hydroxide in suspension in water, soluble acid compounds of arsenic frequently are formed in the product regardless of the care with which the materials are selected and the conditions of reaction are controlled. The presence of the soluble arsenic has been variously ascribed to the formation of calcium monohydric arsenate, to calcium tetrahydric arsenate which compounds may be occluded in the insoluble calcium arsenate and to the formation of some compounds which break down in the presence of water to form a soluble acid arsenate. C. B. Dickey, Corona Chemical Co., Milwaukee, Wisc., has found, U. S. Pat. No. 1,434,650, that the arsenate produced by the reaction of arsenic acid on calcium hydroxide may be largely or substantially freed from soluble acid arsenic compounds either as a part of the manufacture or subsequently, supplying an aqueous suspension of calcium hydroxide containing a concentration of calcium hydrate in actual solution (solution concentration) higher than normal for the temperature of the solution, with which suspension the soluble arsenic compound (or arsenic acid) may react. The higher solution concentration of the calcium hydroxide in the suspension may be secured by the addition thereto of a small proportion (1%) of salt. The soluble compound so added should not, by its own dissociation, increase the calcium ion nor the hydroxyl ion concentration of the solution, or its addition will result in a decrease of the solution concentration of the calcium hydroxide.

Calcium arsenate may be prepared in the customary manner, for example, arsenic acid may be added slowly to a suspension of calcium hydroxide in water, formed preferably by freshly slaking lime, the proportion of calcium hydroxide being somewhat in excess of that required for reaction for the production of a product containing from 40 to 50% As_2O_5. After completion of the reaction dairy salt may be added to the mixture, which increases the solution concentration of the calcium hydroxide and reduces or eliminates the soluble arsenic compounds. The quantity of salt added may be as high as 10% of the arsenate present but a proportion of less than 1 to 5% is used. The mixture may then be heated at 60° C. for about 2-4 hours. The soluble arsenate is thereby reduced to 0.5% or less. A small proportion of the added salt, say from a trace to 0.5%, is allowed to remain in the product, and appears to retard or prevent the tendency for the formation of soluble arsenic compounds.

In treating calcium arsenate containing soluble arsenic to reduce or eliminate the latter, it may be suspended in water with a small amount of slaked lime, say 5%, and about 1% salt and maintained at about 60° C. for 2 to 4 hours. An arsenate containing 2% or more of soluble arsenate may thus have the soluble arsenate content reduced to 0.5% or less.

Chlorinated Derivatives of Hydrocarbons

Many attempts have been made to chlorinate paraffin hydrocarbons by mixing them with a predetermined amount of chlorine in the dark, and then passing this mixture of hydrocarbons and chlorine through transparent tubes before a mercury vapor light, or other source of actinic light, and depending upon the actinic value of the light as a catalyzer, to cause the reaction to take place, with the subsequent formation of chlorhydrocarbons. This method has been found to proceed more or less irregularly and violently, and to result in the products varying in character and amount.

George T. Koch, Ohio Fuel Supply Co., Pittsburgh, Pa., has found, U. S. Pat. No. 1,432,761, that by causing the liquid hydrocarbons of the paraffin series to react with chlorine gas under the influence of actinic rays and in the presence of an absorbent such as silica gel, activated carbon, or pumice, in finely divided condition as a catalyzer, and passing the hydrocarbon liquid and chlorine gas through successive quantities of such absorbent, the reaction can be made to proceed more smoothly, regularly and quickly, and the resulting production of chlorhydrocarbons can be made more definite in character and amount. The reaction can be hastened and improved by impregnating the finely divided absorbent with metals or metal compounds.

As catalyzing material the following substances in finely divided form may be used: Silica gel, which is a hard transparent porous substance of high lustre, being the product obtained when water glass of definite specific gravity is treated with a hydrochloric acid of given strength; batchite, which is activated carbon, as anthracite or bituminous coal, which has been activated by treatment with superheated steam to remove the absorbed hydrocarbons; cocoanut charcoal (Dorsite), which is activated carbon from carbonized cocoanut hulls which has been activated by prolonged treatment with superheated steam; or pumice stone. All of these substances are of a porous structure and possess the property of absorbing large quantities of gases or vapors, and acting as a catalyzer in the chlorination of liquid hydrocarbons.

The reaction chambers used by Mr. Koch are glass tubes of suitable length and diameter fitted into heads or reducers of acid-resistant metal with the aid of a cement of lead oxide and glycerin. The chambers are filled with the adsorbent catalyzing material and so connected with chlorine and hydrocarbon supply tanks and chlorinated hydrocarbon receiver as to permit easily controlled circulation of the reagents and separation of product. Adjacent to the transparent reaction chamber are suitable mercury vapor lamps or other means for producing actinic light rays. The adsorbent material is not altered during the course of the reaction, its function being that of a catalyzer and chlorine carrier and may be used indefinitely without change or renewal if kept free from moisture.

Acid-Proof Castings

Acid resistant ferro-silicon material for chemical equipment, characterized by a high percentage of silicon, 15 to 30 per cent., is very brittle. Ferro-tungsten and ferro-vanadium also are characterized by high resistivity to acid according to the percentage of tungsten or vanadium but are difficult to cast. H. Terrisso and M. Levy, Geneva, Switzerland, have found, U. S. Pat. 1,432,925 that these respective disadvantages may be overcome by combination of ingredients of the two materials. In carrying out the process, iron and silicon are transformed into ferro-silicon with from 10 to 30 per cent of silicon so as to obtain an alloy having a melting point at about 1200 to 1300° C. Ferro-tungsten or ferro-vanadium is then added so as to obtain an alloy containing from 2 to 20 per cent and more of tungsten or vanadium. The castings thus produced will have great brightness and will not tarnish when exposed to the air and they also will have great acid proofness and can be moulded easily. In analyzing such alloys, it has been found that there will exist most probably some ternary combinations of iron, silicon and tungsten or of iron, silicon and vanadium, which combinations are very stable.

Personal Items

H. H. Blaise, formerly chemist, Gulf States Portland Cement Co., Demapolis, Ala., is now chief chemist, Great Western Portland Cement Co., Mildred, Kan.

* * *

Dr. Wm. H. Nichols, chairman of board, Allied Chemical & Dye Corp., has been elected member of the Council, New York University.

* * *

Jerome Alexander, formerly of the Nat'l Gum & Mica Co., New York City, has established himself as a consulting chemist at 52 E. Forty-first St., New York.

* * *

W. W. Heylmun, chief chemist, St. Louis Coke & Chemical Co., Granite City, Ills., has been appointed blast furnace superintendent.

* * *

A. A. Heller has been appointed general manager, Internat'l Oxygen Co., Newark, N. J., to succeed L. W Hench, who has resigned.

* * *

F. A. Anderson, formerly manager of the San Francisco offices, Spencer Kellogg & Sons, Inc., has been appointed manager of the New York office.

* * *

Prof. Chas. F. Chandler celebrated his 56th birthday on December 6, by a small reception in the afternoon at his home, 51 East 54th Street, New York.

* * *

Hugh Kelsey Moore, director of research, Brown Co., Berlin, N. H., has been elected a member of the New Hampshire State Legislature.

* * *

A. A. Heimrod, formerly with the Research Corp., 25 West 43d St., New York, is now chief engineer Federal Phosphorus Co., Birmingham, Ala.

* * *

G. M. Hickley, formerly of Celite Products Co., is now representing the Chemical Equipment Co., Chicago, Ill., at 109 Broad St., New York.

* * *

Preston R. Smith, formerly with the Celluloid Co., Newark, N. J., is now chief chemist, Cupra, Inc., artificial silk manufacturers, Paterson, N. J.

* * *

Prof. Frederick Soddy, University of Oxford, and Prof. F. W. Ashton, University of Cambridge, are the recipients of the Nobel prize in chemistry for the years 1921 and 1922 respectively.

* * *

Mrs. Helen H. Downing, formerly director, department of food economics, Armour & Co., is now with the Calumet Baking Powder Co., Chicago, Ill., in the same capacity.

* * *

F. A. Alter, dyer and chemist, of Connecticut is featured by the Curtis Publishing Co., as successful in the development of "a minor occupation" in the sale of its publications.

* * *

Donald I. Gross, M.I.T.; Eli A. Marcoux, Uni. of Maine.; Russell M. Wiggin, N. H. State College; and Lowell M. Cushing, Tufts College, are recent accessions to the laboratory staff of the Brown Co., Berlin, N. H.

* * *

Stewart E. Seaman, formerly with the Stamsocott Co., Hopewell, Va., and long active in the development of the use of cotton linters in paper manufacture, is now with the Procter & Gamble Distributing Co. in charge of sales of cotton fibre pulp.

Carl G. Schluederberg, president, American Electro-Chemical Society, who is assistant to the managers of the supply and merchandising departments, Westinghouse Electric & Mfg. Co., left recently for a four months' trip in the Orient to study business conditions.

* * *

H. H. Replogle has resigned as manager, intermediates and food color division, National Aniline & Chemical Co., Inc., to become sales manager Wamesit Chemical Co., manufacturers of lactic acid products, Lowell, Mass.

* * *

Prof. R. P. Bigelow, Mass. Inst. of Technology, will have charge of an exhibition of scientific apparatus and products to be held in connection with the Boston meeting, December 26-30, of the American Association for the Advancement of Science. The meeting will be at the Institute.

* * *

H. F. Wilmot, formerly president, Tinc Tura Laboratories, Brooklyn, N. Y., has been appointed technical advisor, Synthetic Organic Chemical Mfrs.' Asso., in matters involving administration of customs duties under the present tariff, with office at 120 Broadway, New York City.

* * *

Paul Seydel, vice-president and E. E. Smith, general sales manager Seydel Chemical Co., Inc., 120 Broadway, New York, are in attendance at the display of the company's products at the Sixth Latin-American Medical Congress in connection with the International Commercial Exposition being held at Havana, Cuba.

* * *

Dr. Chas. L. Reese, chemical director, E. I. du Pont de Nemours & Co., delivered an address on "Science Teaching in Schools and Colleges" at the second annual meeting at Wilmington, Del., Dec. 2, 1922, of the Science Section of the Association of Colleges and Preparatory Schools of the Middle States.

* * *

The American Institute of Chemical Engineers at its 15th annual meeting, Dec. 6-9, at Richmond, Va., re-elected its former officers for the ensuing year. They are Henry Howard, president; John C. Olsen, secretary; F. W. Frerichs, treasurer; Charles F. McKenna, auditor. Edward Bartow, J. V. N. Dorr and R. H. McKee were elected directors for a term of three years.

* * *

Prof. Henry S. Van Klooster of the Department of Chemistry, Rensselaer Polytechnic Institute, Troy, N. Y., will address the Chemical Club of Cooper Union, New York City on Friday P. M., Dec. 22, on the life and service of Louis Pasteur. At a time when American scientific organizations and industrialists concerned with the commercial applications of Pasteur's discoveries are indifferent to the commemoration of the centenary anniversary of Pasteur's birth, the appreciation of his life and service by the Chemical Club of Cooper Union is notable as the only public display of respect to the memory of him who is one of the greatest benefactors in the history of science, save that mentioned on page 554. Prof. Van Klooster and the Chemical Club of Cooper Union are entitled to unusual credit for the effort to bring to the attention of the public its indebtedness to a great chemist and a great bacteriologist.

Industrial Notes

Ford Motor Co., after a year's experiment in glass-making, announces the early establishment of a glass manufacturing plant at its River Rouge plant.

* * *

The latest entrant into artificial silk manufacture is the Cellulose Products Co., Marcus Hook, Pa., which will erect a plant on a 15-acre site at Milford, Del.

* * *

United States Gypsum Co., 205 West Monroe Street, Chicago, has taken title to a 1,000-acre tract of gypsum land at Oakfield, N. Y., and will erect a plant for the manufacture of gypsum products.

* * *

Evans Lead Co., capital $1,000,000, a subsidiary of the Ohio Alloy Co., Fostoria, Ohio, S. M. Evans, Essex Falls, N. J., president, will erect a plant at So. Charleston, Va., for the manufacture of litharge, red and white lead, costing $100,000.

* * *

The Grasselli Chemical Co. has resumed operations at its Terra Haute, Ind., plant, employing about 200 men. The company supplies fuel for this plant as well as others operated by it throughout the Middle West, from its own mine near Terra Haute.

* * *

American Vat Color Mfg. Co., 3223 South Western Avenue, Chicago, Ill., recently reorganized by B. R. Armour, of the Aniline Products Co. and Hayden Chemical Co., will be moved to Lockhaven, Pa., with main offices at 80 Fifth Ave., New York.

* * *

Following upon the provision of the Allied Dye & Chemical Corp., through Dr. William A. Nichols, chairman of the board, for the annual award of $25,000 to the most notable American contributor to chemical science, is the establishment by the General Electric Co. of the Charles A. Coffin Foundation of $400,000, in honor of Mr. Coffin, who in his 78th year, has retired from active leadership in the company after service of 40 years. The annual income from the fund, about $20,000, will go to encourage and reward service in the electrical field by giving prizes to employes, recognition to lighting, power and railway companies for improvement in service to the public, fellowships to graduate students and funds for research work at technical schools and colleges.

The value of the artificial silk yarn produced in the United States in 1922 will be nearly 50 million dollars and the factory value of the finished goods produced therefrom about $75,000,000. Even this growth in domestic production is not sufficient to satisfy the demands of the United States, for the importation from foreign countries during the current year will aggregate about 2 million pounds with a value of 3½ million dollars. The total exports of all artificial silk products in the calendar year 1917, the first year of record, amounted to $1,[illegible],000, advancing to about $10,000,000 in 191[illegible], dropping, however, with the reopening of European factories to about $5,000,000 in 1920, $4,000,000 in 1921 with prospects of increase to about 6½ million dollars in 1922. The growth of this industry in the United States is illustrated by the fact that the domestic output of artificial silk yarn in 1922 is as great as that of the world's production in 1914.

* * *

The decline in Germany's consumption of Chilean nitrate is pronounced. Net imports of Chilean nitrate for seven months in 1922 were 10,557 metric tons and in eight months of 1921, only 16 tons. In 1913, Germany imported 746,811 tons of Chilean nitrate equivalent to about 119,500 tons of nitrogen.

Germany's present estimated production of nitrogen for fertilizers is about 350,000 tons a year. According to the U. S. Trade Commissioner, it is hoped to develop a production of 500,000 tons, sufficient to yield maximum crops from arable land, given an adequate supply of other necessary fertilizers. The supply is obtained as follows:

	TONS
Oppau and Leunawerke (Haber-Bosch process)	150,000
Frank-Caro calcium-cyanamide plants	100,000
Coke-oven products	100,000
Total nitrogen production	350,000

Germany exports nitrogen products to neighboring countries, but the volume is so far negligible.

* * *

Following upon the absorption of the American Brass Co. by the Anaconda Copper Mining Co., whereby an outlet for 450-500 million pounds annually of finished brass and brass products was acquired, comes its absorption of the Chili Copper Co. which owns the largest single deposit of copper ore in the world, estimated at over 700 million tons averaging above 2 per cent copper. With inexpensive open-cut mining and efficient extractive processes, it is claimed to be able to lay down in New York, copper at a cost, exclusive of taxes and interest, of only slightly over 6c. per lb. The combined capacity output of copper of the amalgamated corporations aggregates 550-600 million lbs. per year, which is about 25 per cent of the refinery capacity of the United States. The South American location of the property puts its acquisition outside the purview of the Sherman anti-trust act. Expansion of the company in phosphate and zinc oxide manufacture adds to its supremacy as a great producing-manufacturing unit in copper comparable with the U. S. Steel Corp. in the metallurgy of iron.

FOR RENT

Four story building about 10,000 sq. ft. Equipment includes oil, hydraulic and filter presses, pressure and jacketed tanks, drying rooms, metal dryers, dry and fluid mixers, screens and evaporators. Building and machinery can be converted to suit other chemical processes. The Berg Co., Philadelphia, Pa.

FOR SALE

French Varnish and Color Plant; important location in East of France; 16,000 sq. m. in area; with every facility of transport, railway and water to France, Germany, Belgium, etc.; to be sold or let on lease to American firm. Stock of assorted varnish and dry colors, sulfate of barium, terre de Cassal, etc., also for sale. Write to No. 14099, care Societe Europeenne de Publicite, 10 rue de la Victoire, Paris, France.

RESEARCH CHEMIST WANTED

A manufacturing company will entertain applications for permanent position of research chemist. Experience in [illegible] nitrocellulose solutions, varnishes and similar lines preferable but not essential. Applicants should state full particulars which will be considered confidential. Box [illegible] CHEMICAL AGE.

Volume 30, 1922 **Chemical Age** Lloyd Lamborn, Editor
McCready Publishing Co., 381 Fourth Avenue, New York

INDEX OF CONTRIBUTORS

ASHBY, WILLIAM B. ... I 26
ATTWOOD, WALLACE ... III 101
BELLWOOD, M. I., Mech. E., R. A. Rose, Downs & Thompson, Ltd. ... VII 329
BENJAMIN, EDWARD O., Engineering Chemist ... II 91
BETTS, ANSON J., Chemist and Mining Engineer ... I 21
BLOCK, MAURICE A., Member of New York Bar ... V 201
BOGUE, ROBERT HERMAN, Industrial Fellow, Mellon Institute, Research Chemist, Armour & Co. ... III 103, IV 183
BOWLES, OLIVER, Mineral Technologist, U. S. Bureau of Mines ... I 37
BRYDEN, C. L., Filtration Engineer ... XI 493
BURDICK, M.D., ALFRED S., President, The Abbott Laboratories, Inc. ... V 221
BURRELL, GEORGE A., Consulting Petroleum Engineer ... IV 154
CHASE JR., R. E., Sec., Chemical Engineering Council, Chemical Club, Tacoma, Wash. ... V 210
CHRISTMAN, C. H., Research Chemist, Clinton Corn Syrup Refining Co. ... V 232
CLARK, Ph.D., F.C.I.C., NORMAN ASHWELL, Dept of Chemistry, Iowa State College ... X 460
CLARKE, FRIEND E., Head, Dept. of Chemistry, West Virginia University ... XII 525
CLAUDE, M. GEORGES, L'Air Liquide Anonyme, Paris, France ... XII 537
CLEMENT, J. K., Major, Ordnance Dept., U. S. Army ... V 197
COLE, HOWARD IRVING, Chemist, Bureau of Science, Manila ... X 489
COLLINS, E. F., Industrial Healting Engineer, General Electric Co. ... I 27
CRASS, M. F., The Grasselli Chemical Co. ... VI 246, IX 417
CROUSE, C. A., Professor of Metallurgy, University of Kentucky ... VIII 353
DE LONG, C. R., Chief, Chemical Division, Bureau of Foreign and Domestic Commerce ... X 431
DE WOLF, PHILIP, Industrial Engineer, Louis Schlesinger, Inc. ... IX 390
DOWNING, JR., WILLIAM F. ... I 17
DYES, DR. W. A., Consulting Chemist and Economist ... X 466
EISENSCHIML, OTTO, Manager, Scientific Oil Compounding Co. ... III 139, V 233
ELLERY, DR. EDWARD, Dean of the Faculty, Union College ... XI 473
FEUERBACHER, FRED W., Accountant, Pease Laboratories, Inc. ... XI 497
FISCHER, A. H., President, Schutte & Koerting Co., XI 501, XII 547
FULLER, F.C.I.C., DR. ELLIS I., Asso. Professor of Bio-Chemistry, Iowa State College ... X 450
FUNK, DR. CASIMIR, Associate in Biological Chemistry, College of Physicians and Surgeons, Columbia University; Head, H. A. Metz Research Laboratory ... V 227
FURNESS, M. Sc., R. G. ... IV 173
GARDNER, GUY, A., Manager, Chemical Department, M. Gottesman & Co., Inc. ... IX 388
GARMAN, HARRY O., President, American Association of Engineers ... VII 331
GARVAN, FRANCIS P., President, The Chemical Foundation, Inc. ... III 97, 127
GILCHRIST PETER S., President, Chemical Construction Co. VI 257
GINSBERG, B. Sc., Chem. Eng ... XI 487
GOETSCHIUS, D. M. Engineering Chemist ... III 102
GRENFELL, DONALD S., New Jersey Zinc Co. ... III 114
HADDEN, S. C., Editor, Municipal & County Engineering VIII 349
HART, Ph.D., EDWARD, Professor of Chemical Engineering, Lafayette College ... IX 401, X 446, XI 505, XII 540
HAYNES, R. A., Federal Prohibition Commissioner ... IV 165
HERMAN, K. I., President, K. I. Herman Chemical Corp ... XII 533
HOLMES, Ph.D., MAJOR E., Manager, Chemical Dept., Nat'l. Lime Association ... III 129
HOOVER, HERBERT, Secretary of Commerce ... V 193
HOLZ, HERMAN A. ... VIII 340
HOWARD, FRANK A., President, Standard Development Co ... XII 523
HOWARD, HENRY, Chairman, Executive Committee, Manufacturing Chemists' Association of the U. S. ... VI 279, XII 525
HOWARD, DR. L. O., Chief, Division of Entomology, Bureau of Plant Industry, U. S. Dept. of Agriculture ... I 5
HYDE, EDWARD P., Director of Research, Nat'l. Lamp Works of General Electric Co. ... VII 259
INGALLS, W. R., Consulting Engineer ... III 100
JACOBSON Ph.D., C. A., Professor of Chemistry, West Virginia University ... II 51
JOHNSON, JOSEPH FRENCH, Dean New York University School of Commerce ... II 49
JOHNSON, Ph.B., LEHMAN, Official Chemist, Memphis Merchants' Exchange ... VII 334
KARRICK, LEWIS C., Associate Oil Shale Technologist, U. S. Bureau of Mines ... III 112
KINGSBURY, PERCY, Chief Engineer, General Ceramics Co ... XII 551
LADOO, RAYMOND B., Mineral Technologist, U. S. Bureau of Mines ... II 77
LANDIS, WALTER S., Chief Technologist, American Cyanamid Co.; Past President, American Electrochemical Society IV 149, V 207
LE FEVRE, DR. EDWIN, Chemist, Microbiological Laboratory, Bureau of Chemistry, U. S. Dept. of Agriculture ... I 34
LYTHGOE, HERMANN C., Director, Division of Food and Drugs, Massachusetts Dept. of Public Health ... VII 293, X 463
MacDOWELL, DR. CHARLES H., President, Armour Fertilizer Works ... II 83, VI 271
McKEE, DR. RALPH H., Professor of Chemical Engineering, Columbia University ... I 1
McKERROW, H. GARDNER ... IX 373
MAISTRE, CHARLES le, Secretary British Engineering Standard Association ... V 227
MATHESON HOWARD W., Vice-President, Canadian Electro Products Co. ... X 464
MATTHEWS, JOHN A., President, Crucible Steel Co. of America ... XII 521
MANNING, DR. VAN H., Director of Research, American Petroleum Institute ... IV 161
MONTAGUE, GILBERT H., Member of the New York Bar ... II 64
MOORE, HUGH KELSEY, Director of Research, Brown Co. VI 273
MAYNARD, Ph.D., T. POOLE, Geological and Industrial Engineer ... II 56
MULLER, ALFRED, Member, American Patent Law Association ... X 441
MURRAY, K. S., British Oxygen Co. ... XI 475
NOEL, M.E., W. A., Associate Development Engineer, Office of Development Work, Bureau of Chemistry, U. S. Dept. of Agriculture ... IX 381
O'BRIEN, RUTH, Associate Professor of Textile Chemistry, Iowa State College ... III 101
OLSEN, DR. JOHN C., Secretary, American Institute of Chemical Engineers ... IX 394
PARISH, WILLIAM F., President, American Society of Lubrication Engineers ... II 61
PARKER, ALBERT E., Member New York Patent Law Association ... IV 185
PARSONS, DR. CHARLES L., Secretary, American Chemical Society ... VI 276
PEARCE, DR. W. T., Head, School of Chemistry, North Dakota Agricultural College ... X 439
PLATT, Ph.B., M.A., Washington, Production Manager, Harris Laboratories ... IV 157, V 203
POORE, H. D., Asst. Chemist, Lab. of Fruit and Vegetable Chemistry, Bureau of Chemistry ... X 433
POSTE, EMERSON. P., Director of Laboratories, Enameled Products Co. ... X 435
PRICE, M.B.A., M.A., S. REGINALD, General Secretary, British Association of Chemists ... VI 261
RANSDELL, JOS. E., U. S. Senator from Louisiana ... X 425
RECTOR, THOMAS M., of Rector & Tenney, Chemists and Engineers ... II 74
ROSEN, M.B.A., C.P.A., C.B.E., of Chas. S. Rittenhouse & Co. . I 29
ROAST, F.C.S., F.C.I.C., HAROLD J., Secretary Canadian Institute of Chemistry ... I 7
ROBERTSON, Ph.D., H. E. ... II 59
RICHTER, GEORGE A., Research Dept., Brown Co. ... X 443
ROWLAND, J. M., Chief Engineer, Hooker Electrochemical Co. ... VII 299
RUNGE, DR. WALTER, Vice-President and General Manager, The Bregeat Corp. o.f America ... I 29
SCOTT, DR. WILLIAM DILL, President, Northwestern University ... IV 151
SEIDELL, ATHERTON, Technical Assistant, U. S. Public Health Service ... IV 180
SEIDELL, L. R., Managing Director, New York Testing Laboratories ... II 89, IX 385
SHIVELY,R. R., Chemical Engineer, Monongah Glass Co. .VII 296
SIMSOHN, JULIAN S., Consulting Chemical Engineer ... I 43
SKINNER, C. E., Assistant Director of Engineering, Westinghouse Elec. & Mfg. Co. ... IV 168
SKINNER, DR. W. W., Assistant Chief, Bureau of Chemistry, U. S. Dept. of Agriculture ... VI 247
SHOLES, CHARLES E. ... II 90, V 216
SOULE, Chem. E., Ph.D., ROLAND P., Dept. of Chemical Engineering, Columbia University ... VI 251
STARK, WILKINSON, Chemical Engineer ... X 457, XI 500, XII 555
STONE, CHARLES H., The Textile Alliance, Inc. ... IX 387
STOUGHTON, BRADLEY, Consulting Engineer ... III 131
STRACHAN, DR. E. K., Assistant Professor of Physical Chemistry, Brown University ... VIII 363
STULL, R. T., Supervising Ceramist, U. S. Bureau of Mines VII 318
TAYLOR, GUY B., Experimental Station, E. I. du Pont de Nemours & Co. ... VI 244
TAYLOR, HUGH S., Associate Professor of Physical Chemistry, Princeton University ... VII 339
THATCHER, Ph.D., C. J., Vice-President and Technical Director, Thatcher Process Co., Inc. ... IV 187
THIELE, Ph.D., LUDWIG A., Consulting Chemical Engineer, VI 279, VII 329
THOMAS, ARTHUR W., Assistant Professor of Food Chemistry, Columbia University ... II 54
THOMAS, KIRBY, Consulting Engineer ... VIII 344
THOMAS, DR. JOHN M., President, Pennsylvania State College, VIII 337
TIGERT, JOHN J., U. S. Bureau of Education ... III 115
TURRENTINE, J. W., Scientist-in-Charge, Experimental Kelp-Potash Plant, U. S. Bureau of Soils ... V 224
VAIL, JAMES G., Chemical Director, Phila. Quartz Co. ... I 19
VAN DOREN, Ph.D., LLOYD, Consulting Chemist; Patent Attorney, Duell, Warfield & Duell, IV 189, V 235, VI 283, VII 333, VIII 365, IX 420, X 467, XI 513, XII [illegible]
VAN KLOOSTER, H. S., Assistant Professor of Chemistry, Rensselaer Polytechnic Institute ... XI 479
WAGGAMAN, WM. H., Scientist in Fertilizer Investigations, U. S. Bureau of Soils ... VII 302
WAGNER, THEODORE B. ... XII 550
WALLACE, L. W., Executive Secretary, The Federated American Engineering Society ... II 81
WARDENBURG, F. W. A., Assistant Chief Engineer, E. I. du Pont de Nemours & Co. ... II 57
WEIDLEIN, EDWARD R., Director, Mellon Institute of Industrial Research of the University of Research ... VI 241
WHITMAN, W. G., Assistant Professor of Chemical Engineering, Massachusetts Institute of Technology ... IX 377
WINSLOW, CARLILE P., Director, Forest Products Laboratory ... IV 145
WITT, J. C., Lewis Institute, [illegible] ... XII [illegible]

INDEX OF SUBJECTS

Abrasives, Artificial Aluminous. .... III 110
Acetaldehyde from Acetylene. By Howard W. Matheson, Vice-President, Canadian Electro Products Co. .... X 464
Acetic Acid, Synthetic .... IV 155
Acetic Anhydride, Manufacture of .... II 70
Acids and Accidents. By Charles E. Sholes .... V 216
Acids, Safety in the Handling and Use of. By Maurice F. Crass, The Grasselli Chemical Company. Illustrated .... IX 417
Adhesives from Starch .... VII 323
Agricultural and Mechancial College of Texas. Growth and Products of a Technical Servant of the Great Southwest. Illustrated. .... VII 805
Alcohol, Industrial Production and Uses in the Philippines. By Howard I. Cole, Chemist, Bureau of Science, Manila.... XI 489
American Association of Engineers. By Harry O. Garman, President. .... VII 331
American Association of Textile Chemists and Colorists.... XII 534
American Institute of Chemical Engineers. A Summary of Its Accomplishments in the Establishment of the Professional Status of the Chemical Engineer and a Statement of its Influence in the Promotion of Chemical Engineering Education and Chemical Industry. By Dr. John C. Olsen, Secretary, American Institute of Chemical Engineers. Illustrated. .... IX 394
American Institute of Chemistry. By Norman Ashwell Clark, Ph.D., F.C.I.C., Dept. of Chemistry, Iowa State College.. X 460
American Institute of Chemistry ....I 25, II 75, III 124
American Institute of Chemistry in New Jersey, First Steps Towards Organization of the .... II 78
American Oil Chemists' Society .... V 220, VI 281
American Valuation, A Plea for. By Francis A. Adams.... VII 292
Analytical Laboratory, The Commercial .... III 133
Appliances for Moving Liquids in Chemical Plants. By A. K. Fischer, President, Schutte & Koerting Co. Illus., XI 501, XII 547
Application of New Knowledge to Industry .... I 15
Arsenical Insecticide, Improved .... VI 250
Attendance at Engineering Colleges in the United States..... VI 243
Bauxite and Aluminum. Concentration of Low-Grade Bauxites. Expiration of Basic Patents and Hydroelectric Development Promise Expansion in Aluminum Production. By T. Poole Maynard, Ph.D., Geological and Industrial Engineer. .... II 86
Benzoic Acid Standards. By Nathan R. Levy .... II 69
Benzol Poisoning: Its Occurence and Prevention. By Charles F. Horan, Manager, Department of Hygiene and Safety, Hood Rubber Company .... IX 407
Biscuit and Cake Manufacture. Influence on Finished Products of Several Ingredients with Special Reference to the Action of Milk. By Washington Platt, Ph.B., M.A., Production Manager, Harris Laboratories. Illustrated....... IV 157, V 203
Bleaching Powder. .... VI 266
Brewing Industry's Hopes .... XII 530
Brick from Blast Furnace Slag .... VII 301
British Association of Chemists. By S. Reginald Price, M.B.E., M.A., Gen. Sec., British Association of Chemists. .... VI 261
Butter, Fiat .... VII 328
Butter-Fat Standard, Proposed. By Hermann C. Lythgoe, Director, Division of Food and Drugs, Massachusetts Department of Public Health. Illustrated .... X 463
Business, How the College Can Facilitate Payment of the Debt It Owes to. By Dr. Edward Ellery, Dean of the Faculty, Union College. Illustrated .... XI 473
Business, Some Basic Considerations of American. By Joseph French Johnson, Dean, New York University School of Commerce. Illustrated .... II 49
Butyric Acid as a By-Product of Yeast Manufacture...... III 117
By-Product Coke Industry, Freight Rates and .... II 64
Calcium Arsenate .... XII 539
Camphor Industry, A Domestic Synthetic. Illustrated....... V 211
Camphor Substitutes in Plastics Manufacture .... III 111
Canadian Institute of Chemistry. A Review of Growth of the Idea. Its Organization, Functions and Future. By Harold J. Roast, F.C.S., F.C.I.C., Secretary, Canadian Institute of Chemistry. Illustrated .... I 7
Canadian Institute of Chemistry .... II 66, V 214
Canadian Institute of Chemistry. By Dr. Ellis I. Fulmer, F.C.I.C., Asso. Prof. of Inorg. Chemistry, Iowa State College .. X 450
Canadian Institute of Chemistry Year Book .... V 200
Carbon, American Production of Activated. Illustrated .. IX 414
Carbon Black from Natural Gas in 1921 .... IV 164
Carbon Black Manufacture Declared Unconstitutional, Montana Law Restricting Use of Natural Gas in .... VI 256
Carbon Bisulphide, Manufacture of. By Geo. A. Richter, Research Department, The Brown Co. Illustrated .... X 443
Carbon Dioxide at Mellon Institute, Research on Liquid .... XI 478
Carbon Tetrachloride in Fire Extinguishers .... VII 324, VIII 351
Casale Catalytic Apparatus for Ammonia Synthesis .... IV 166
Catalysis and Catalysts in Chemical Processes. By Hugh S. Taylor, Associate Professor of Physical Chemistry, Princeton University. Illustrated .... VII 309
Catalyzers, Regeneration of, in Oil Hardening .... V 220
Cerium, Limitations of [illegible] .... X 465
Chemical Age, The, and the Potentialities of the South in the Industrial Applications of Chemistry. By Jos. E. Ransdell, U. S. Senator from Louisiana. Illustrated .... X 425
Chemical Calculations, [illegible] Calculating Machine for. By C. A. Jacobson, Professor of Chemistry, West Virginia University .... II 51
Chemical Cost Accounting, Some Phases of. By C. B. E. Rosen, M.B.A., C.P.A. .... I 20
Chemical [illegible] at Johns Hopkins. The Erection of the New Chemical Laboratory Directs Attention to the Influence of [illegible] Chemical Education, and Chemical Industry in America. The Laboratory will Mark a New Era in the History of Chemistry at this Institution. Illustrated .... IX 410
Chemical [illegible] and [illegible] of West Virginia. By [illegible] Head, Department of Chemistry, West Virginia University. Illustrated .... XII [illegible]
[illegible] .... XII [illegible]
[illegible] .... XI 482, XII 531
Chemical [illegible] .... III 126
Chemical [illegible] .... V 210, VII 308
Chemical [illegible] .... X 455
Chemical [illegible] .... VIII 348, IX 396
[illegible] By Philip DeWolf, [illegible] Illustrated .... IX 390
Chemical Industry, Political History, Economics and Future of Our Organic. By H. Gardner McKerrow. Illustrated IX 373
Chemical Industry, Service of Department of Commerce to. By C. R. DeLong, Chief, Chemical Division, Bureau of Foreign and Domestic Commerce, Dept. of Commerce .... X 431
Chemical Industry, Uniform Cost Accounting in. Illustrated.. X 445
Chemical Laboratories, Cost Accounting in. By Fred W. Feuerbacher, Accountant, Pease Laboratories, Inc., New York. XI 497
Chemical Laboratory, New, at Brown University. Illus. .... III 122
Chemical Manufacture, Future Methods of Organic. By Dr. E. K. Strachan, Assistant Professor of Physical Chemistry, Brown University; Formerly Chemical Engineer, National Aniline & Chemical Co. .... VIII 363
Chemical Manufacture, Synthetic Medicinal, in America. By Alfred S. Burdick, M.D., President, The Abbott Laboratories .... V 221
Chemical Plants, Fire Hazards in .... IV 181
Chemical Plants, Safe Handling of Materials in. By W. G. Whitman, Assistant Professor of Chemical Engineering, Massachusetts Institute of Technology. Illustrated...... IX 377
Chemical Foundation, Inc., The .... VII 321
Chemical Foundation, Inc. A National Public Utility for American Welfare Through the Development of Chemical Industry. By Francis P. Garvan, President, The Chemical Foundation, Inc. Illustrated .... III 97
Chemical Foundation, Inc., Stockholders of the .... IX 379
Chemical Foundation Patent Royalties .... VIII 360
Chemical Segregation in America .... VI 277; VIII 361, X 451
Chemical Stoneware. By Percy Kingsbury, Chief Engineer, General Ceramics Co. Illustrated .... XII 551
Chemical Warfare .... I 32
Chemical Warfare Preparedness .... VII 314
Chemically Trained Man, The, and Citizenship. By R. E. Chase., Jr., Secretary, Chemical Engineering Council, Olympic Chemical Club, Tacoma, Wash. .... V 210
Chemicals, Industrial, During the Past Year. By Guy A. Gardner, Manager, Chem. Dept., M. Gottesman & Co., Inc. IX 388
Chemist, The, and Advertised Goods .... VII 298
Chemists, A Call for, in the Government Service .... IV 172
Chemist, Advice to the Young .... II 63
Chemist, The, and Boll-Weevil Control. By Lehman Johnson, Ph.B., Official Chemist, Memphis Merchants' Exchange.. VII 332
Chemist, Cogitations on the .... I 18
"Chemist, Cogitations on the," Comment on. By L. R. Seidell, Managing Director, New York Testing Laboratories..... II 89
Chemist, The, and Chemical Control in Industry. An Appreciation of the Factory Chemist and a Recommendation of His Usefulness in Paper-Board Manufacture. By K. I. Herman, President, K. I. Herman Chemical Corp. .... XII 533
Chemist, Disclosure by the, of Confidential Information .... V 226
"Chemist, Do You Use a, in Your Business?" .... VI 276
Chemist in the Dyeing and Cleaning Industry. By Ruth O'Brien, Associate Professor of Textile Chemistry, Iowa State College. Illustrated .... III 101
Chemist, Material Welfare of the. Importance of Subject Demands Discussion. By C. H. Christman, Research Chemist, Clinton Corn Syrup Refining Co. .... V 232
Chemist, Mid-West Opinion on the Formation of an Economic Organization of. By Otto Eisenschiml, Manager, Scientific Oil Compounding Co.; Pres., Chicago Chemists' Club.... V 233
Chemistry, International Relations in. A Plea for the Resumption of International Comity in Chemistry. By Dr. W. A. Dyes, Consulting Chemist and Economist; Editor and Publisher, Handbook of the World's Chemical Industry and Trade. Illustrated .... X 466
Chemistry, The Practice of Consulting, as a Profession in New New York. By L. R. Seidell, Manager, Testing Laboratories of New York, Inc. .... IX 385
Chemistry, Some Economic Aspects of the Practice of. By Otto Eisenschiml, Manager, Scientific Oil Compounding Co.; President, Chicago Chemists' Club .... III 139, IV 177
Chemistry, Women in. A Study of Professional Opportunities .... VI 268
Chemists, More, and the Service of Penn State College in Their Production. By Dr. John M. Thomas, President, Pennsylvania State College. Illustrated .... VIII 337
Chemists, Dividends and the Eastman Kodak Co. ....V 200
Chemists, Portrait Series of Eminent American
  Baekeland, Dr. Geo. H. .... II 71
  Chandler, Dr. Charles Frederick .... IX 397
  Gilchrist, Peter S. .... IV 169
  Hart, Dr. Edward .... XII 543
  Howard, Henry .... I Cover
  Swain, Dr. Robert E. .... V 217
  Walker, Dr. William H. .... VI 263
  Wesson, David .... VII 315
  Whitaker, Dr. Milton C. .... VIII 355
  Whitney, Dr. Willis R. .... III 119
Chemist and the Urge for More Business. The Factory Duplication of Competitors' Products and Its Legal Limitations in Sales Policies .... II 79
Chemist, Work of the, in Portland Cement Manufacture. By F. C. Witt, Lewis Institute, Chicago .... XII 526
Chemist's Work, Some Conditions of the. By George L. O'Brien, Plant Manager, O'Brien Varnish Co., South Bend, Ind. VIII 341
Chlorine in Paper Making. Will the Manufacture of Pure Cellulose from Wood and Straw Provide a New Outlet for Chlorine? By Ismar Ginsberg, B.Sc., Chem. Eng. .... XI 487
Chromic Acid, Regeneration of, Used in Organic Oxidation. Illustrated .... III 141
Coal Products, Low Temperature Distillation of. By Dr. Walter Runge, Vice-President and General Manager, The [illegible] Corp. of America .... I 9
Coal Tar, Low Temperature, Markets for. By Roland P. Soule, Chem. E., Ph.D. .... VI 251
Compensation Schedule, Some Mistakes in Recommendations under the National Workmen's. By Charles E. Sholes II 90
Condensation Products Manufacture, Combination in .... VI 246
Copper and Copper Alloys in the Chemical and Allied Industries. By Wilkinson Stark, Chemical Engineer. Illustrated X 457, XI 500, XII 555
Copper Salts Improve Casein Glue .... V 225
Constructive Criticism .... X 456
Cracking, The Place of, in Chemical Technology. Development of the Cracking Process and Its Present Status from the Patent Standpoint. By Frank A. Howard, President, Standard Development Co. .... XII 523
[illegible] Process, [illegible] of the. By Dr. [illegible] .... VI 270

De-Inking Printed Paper with Bentonite ....VIII 348
Dryers for Fine Chemicals Illustrated..... ....X 444
Du Pont Chemical Fellowships ....I 28
Du Pont Men, Thirteen Points Demanded of . ...XI 482
Du Pont Securities on the New York Stock Exchange........VI 272
Dyes and Coal Tar Chemicals, 1921, Census of VII 325
Dyes, The Commercial Significance vs. the National Importance of Coal Tar. By Charles H. Stone, Textile Alliance, Inc. Illustrated ....IX 387
Dyestuffs Manufacture, The Situation in....................VII 319
Dyestuffs Trade Mark for China. Illustrated................X 428

Editorials, I 22, II 72, III 120, IV 170, V 218, VI 264, VII 316, VIII 356, IX 398, X 452, XI 498, XII 541
Electric Heat for Thermal Processes. By E. F. Collins, Industrial Heating Engineer, General Electric Co. Illus....I 27
Electrochemical Industry, Geographical Aspects of. By Walter S. Landis, Chief Technologist, American Cyanamid Co...V 207
Employment Contracts Involving Inventive Service. By Lloyd Van Doren, Ph.D.... ... . XII 539
Engineers' License Law in New York and Pennsylvania......I 6
Ethyl Alcohol from Western Larch..........................IX 389

Fat and Oil Industries, Growth of the American. By Dr. W. W. Skinner, Assistant Chief, Bureau of Chemistry, U. S. Dept. of Agriculture. Illustrated............................VI 247
Fibres, Vegetable, Imparting the Characteristics of Wool to...I 20
Filter Press, Development of the. By C. L. Bryden, Filtration Engineer ....XI 493
Filter, A Handy. Illustrated................................X 462
Fixed Nitrogen Research Laboratory. Illustrated..........VI 266
Flooring, Composition ....IX 416
Food Research Institute of Stanford University.............V 199
Food Research Institute, Staff of..........................VIII 362
Forest Products Industries of the South. Role of Chemistry in the Conservation of Its Timber Resources. By Carlile P. Winslow, Director, Forest Products Laboratory, Madison, Wis. Illustrated ....IV 145
Fuel Costs and the Plant Executive.....................VIII 343
Fuller's Earth, Vitamin-Activated, Preparation of. By Atherton Seidell, Tech. Asst., U. S. Public Health Service........IV 180

Gas Absorption, A New Device for. By H. E. Robertson, Ph.D., Research Engineer. Illustrated..........................II 59
Gas, Compressed, Manufacturers' Association.............. XII 538
Gas Consumption from Monroe, La., Wells Reduced.........III 123
Gas in the Preservation of Canned Food. Use of Inert. By Thomas M. Rector, Consulting Chemical Engineer......II 74
Gas Masks, Industrial Uses of. By H. Foster Bain, Director, U. S. Bureau of Mines...I 16
Gas Measurement in New York City, Heat Standard of........I 4
Gas Warfare Condemned...I 42
Gases, Industrial, and Their Containers. By Edward O. Benjamin, Engineering Chemist. Illustrated................II 91
Gasoline, Conversion of Petroleum Residuum into. Address of Acceptance of Dr. William M. Burton, President, Standard Oil Co. of Indiana, on the Award of the Perkins Medal, January 13, 1922, at Rumford Hall, New York..........I 35
Gasoline from Oil Shale. Substitutes for Gasoline. Research in Oil Shale Utilization at Columbia University. By Dr. Ralph H. McKee, Professor of Chemical Engineering, Columbia University. Illustrated..........................I 1
Georgia Clays, Investigation of, by the Bureau of Mines....IV 179
German Research and Appeals for American Aid............V 230
Germany, Bankruptcy of.....................................XI 492
Glucose Manufacture, Improved Procedure in..............VI 253
Glues, Water Resistant: Casein and Blood Albumin. By Robert Herman Bogue, Industrial Fellow, Mellon Institute; Research Chemist, Armour & Co. Illustrated..........III 103
Gold, Synthetic ....I 42
Government Phenol for Sale..................................V 212
Glycerin, Production of, by Fermentation..................IX 429

Hazards in the Repair of Acid Eggs and Blowcases. By M. F. Crass, The Grasselli Chemical Co.......................VI 246
Hydrochloric Acid by the Direct Union of Hydrogen and Chlorine. By Hugh Kelsey Moore, Director of Research, Brown Co. Illustrated.................................VI 273
Hydrochloric Acid Process, Townsend. Illustrated..........VI 275
Hydrogen, Manufacture of. By M. Georges Claude, L'Air Liquide Anonyme, Paris, France. Illustrated......... XII 537
Hydrogen Sulphide, Manufacture of. By Henry Howard, President, American Institute of Chemical Engineers ... XII 525
Hydrogenation of Naphthalene. Tetra- and Deca-hydro Naphthalenes as New Industrial Products. By R. G. Furness..IV 173

Industrial Notes, I 48, II 96, III 144, IV 192, V 240, VI 288, VII 336. VII 372. X 472. XI 520. XII 564
Industrial Research Must Justify Itself in Economies. Research Chemists Cannot Be Employed if Results Do Not Show a Profit. By F. A. Wardenburg, Asst. Chief Engineer, E. I. du Pont de Nemours & Co.................................II 57
Industry, The Human Element in. By W. Harrison, M.Sc..VIII 358
Inks, Manufacture and Properties of Writing. By Frank F. Rupert, Industrial Fellow, Mellon Institute. Illus.....VIII 345
Insects, The War Against. The Insecticide Chemist and Biologist in the Mitigation of Plant Pests. By Dr. L. O. Howard, Chief, Division of Entomology, U. S. Dept. of Agriculture. Illustrated ....I 5
Institution of Chemical Engineers..........................V 202
Institute of Chemistry of Great Britain...................III 116
Invertase in Cane Syrup Manufacture......... ....IV 156
Iron, Commercial Pure, and the "Direct Process." By Bradley Stoughton, Consulting Engineer, Past Secretary, American Institute of Mining and Metallurgical Engineers........III 131
Iron, Stainless ....XI 474
Isinglass: Its Sources, Manufacture, Composition, Properties, Adulteration and Uses. By Robert Herman Bogue, Industrial Fellow, Mellon Institute; Research Chemist, Armour & Co. ....IV 183

Job, The Fine Art of Finding a. A Brief Treatise on the Salesmanship of Technical Service.........................VI 255
Jingles of Science...I 24

Kelp-Potash Plant of the Bureau of Soils, Work of the Experimental. By J. W. Turrentine, Scientist-in-Charge, Experimental Kelp-Potash Plant, U. S. Bureau of Soils........V 224

Lactic Acid and the Tariff Schedule........................V 196
Lead Arsenate Manufacture, New Catalyst in I 24
Leather, Artificial, Free from Clothy Appearance............III 126
Leather Manufacture. Increased Efficiency Is Possible Through Research in Fundamentals. By Arthur W. Thomas, Asst. Prof. of Food Chemistry, Columbia University............II 54
Lemon Residue, Destructive Distillation of. By H. D. Poore, Assistant Chemist, Laboratory of Fruit and Vegetable Chemistry Bureau of Chemistry U. S. Dept. of Agriculture X [illegible]
Lime Specifications for Glass Manufacture. By R. R. Shively, Chemical Engineer, Monongah Glass Co....................VII 296
Lime, Use of, in the Textile Industry. By Major E. Holmes, Manager, Chemical Department, Nat. Lime Association..III 129
Lubricating Oil Business and the Work of the Lubrication Engineeer. By William F. Parish, President, American Society of Lubrication Engineers.....................II 61

McAfee Process of the Cracking of Petroleum by the Use of Aluminum Chloride as Catalyst.........................IX 406
Magnesium Production, American.........................VIII 342
Manufacturing Chemists' Association, Officers of the........VI 262
Manufacturing Chemists' Association. Report of Executive Committee for Year Ended May 31, 1922. By Henry Howard Chairman .... VI 281
Margarin Manufacture, Improved Process of. By William T. Ashby ....I 26
Margarin and Vitamines..I 41
Massachusetts Institute of Technology, Aeroplane View of....I 31
Mellon Institute, The Work of...............................IX 376
Metal Mining, Conditions in, and Recommendations for Relief. By W. R. Ingalls, Consulting Engineer.................III 100
Milk for Beverage Use, Preservation of.....................II 53
Mixer, A Handy. Illustrated.................................XI 488
Muscle Shoals and Henry Ford...............................II 67
Muscle Shoals, Common Sense—and Fertilizer Manufacture at. By Walter S. Landis, Chief Technologist, American Cyanamid Co.; Past Pres., Amer. Electrochemical Society IV 149
Muscle Shoals, Domestic Potash and Henry Ford. By Dr. Charles H. MacDowell, Pres., Armour Fertilizer Works..VI 271

National Academy of Sciences and National Research Council, New Building of...XI 497
Nitro-Cellulose Compositions, Colored........................I 24
Nitro-Cellulose Films Condemned............................X 465
Newark Technical School, College of Engineering of the. Illus...1 11
New Jersey Chemical Society....I 16, II 52, III 118, IV 180, V 198
Nitric Acid from Saltpeter or Synthetic Ammonia. Cost Factors and Conditions That Will Determine the Raw Material of Nitric Acid Manufacture. By Guy B. Taylor, Experimental Station, E. I. du Pont de Nemours & Co. Illustrated....VI 244
Nitrogen Fixation, Government Research in.............. XII 535
Nitrogen Fixation, The Future of, in the United States. By J. K. Clement, Major, Ordinance Dept., U. S. A............V 197
Non-Cracking Patent Leather.................................V 220

Oil Shales of Kentucky. In the Publicity of Western Oil Shales as a Potential Source of Hydrocarbon Fuel Have Been Overlooked the Superior Commercial Possibilities of Deposits Near at Hand. By C. A. Crouse, Professor of Metallurgy. University of Kentucky. Illustrated................VIII 353
Oil Shale Development, Leaders in..........................XI 508
Oil Shales, Some Factors Affecting the Products of the Destructive Distillation of. By Lewis C. Karrick, Associate Oil Shale Technologist, U. S. Bureau of Mines. Illustrated..III 112
Oil Shale Treatment Processes, Observations on. By Kirby Thomas, Consulting Engineer .. .. .VIII 344
Organization and Management. Principles of Advice to Plant Executives and to All Industrial Workers Aspiring to Administrative Responsibilities. By Wallace Attwood.....III 107
Oxygen, Cheap. By Anson G. Betts, Chemist and Mining Engineer ....I 21
Oxygen Production by the Claude Process.... . . ... .V 215
Oxygen Production from Liquid Air. By K. S. Murray, British Oxygen Co. Illustrated................................XI 475

Packing Industry, Adjustment in the........................I 14
Pasteur, Louis, 1822-1895. A Timely Resumé of the Life and Service of a Great Creative Chemist. By H. S. Van Klooster, Assistant Professor of Chemistry, Rensselaer Polytechnic Institute. Illustrated...........................XI 479
Patent Exposition ....XI 497
Patent History, Some. Its Lesson to American Chemistry....III 127
Patent Law, The "Working Clause" in Our. By Albert E. Parker, Patent Counsel; Member, New York Patent Law Association ....IV 185
Patents, Current Chemical, and Patent Problems. By Lloyd Van Doren, Ph.D., Consulting Chemist; Patent Attorney, Duell, Warfield & Duell, IV 189, V 235, VI 283, VII 333, VIII 365, IX 420, X 467, XI 513, XII 559
  Acid-Proof Castings . . XII 562
  Activating Animal and Vegetable Fibres...............IX 423
  Aluminum Chloride, Henry Howard's Way of Making..XI 517
  Anthraquinone Manufacture ....VI 286
  Anthraquinone, Purification of....................VIII 368
  Antimony Colors, Dry Process Manufacture of.......VI 286
  Antimony Trichloride ....IX 421
  Apple Oil, Synthetic.....................................XII 562
  Arsenate of Lead Manufacture..........................X 469
  Asbestos Cement Shingles Waterproofing .... . .IX 422
  Bakelite, A Partial Substitute for.....................IX 424
  Benzyl Alcohol Free of Chlorine......................VII 333
  Bleaching Powder, Increasing Efficiency of...........V 237
  Building Material from Corn Cobs....................XI 515
  Buttermilk in Form of a Soluble Powder..............XI 517
  Buttons from Gypsum.....................................XII 559
  Butyl Alcohol and Acetone by Fermentation..........XI 515
  Calcium Arsenate XII 562
  Canned Heat from Colloids VI 285
  Carbon Black Production..............................VIII 368
  Catalyst, Composite ....VIII 360
  Caustic Alkali, Eliminating Color from...............VI 284
  Celluloid, Increased Flexibility of, Without Castor Oil.XI 517
  Cellulose Butyrate ....IX 421
  Charcoal to Extract Constituents of Coal Gas..........V 236

Chlorinated Derivatives of Hydrocarbons ....XII 562
Chlorinating Gaseous Hydrocarbons..................IX 422
Chlorine, Deodorization with ....IV 189
Chlorine as a Desulphurizing Agent in Ferrous Metallurgy ....IX 423
Cold Water Paint..X 468
Colloidal Sulphur..XII 561
Composition Roofing, Utilizing Trimmings of........VIII 367
Condensation Products of Phenol.....................V 238
Cork Substitute from Wood............................XI 516
Coumarone Resin ....VI 285
Cyanamid Nitrogen in Fertilizer, Increased Availability of ....V 237
Cyanogen from Coke Oven Gases, Extracting..........V 238
Detinning Scrap Iron..V 236
Dextrin Manufacture ....X 469
Drying Oils, Synthetic......................................V 236
Electrical Precipitator, Self-Cleaning.................V 236
Fire Extinguisher from Waste Pulp Liquor..........XI 516
Glass, Ingredients of a, to Separate Ultra-Violet from Visible Light Rays.............................VI 285
Glycerol-Polybasic Acid Resins.......................VIII 367
Gum Dammar as an Emulsifying Agent..............XII 560
Hardening Rosin for Varnish Manufacture............XI 546
Hydrogen Peroxide-Sulphur Dioxide Bleach...........VI 286
Kid-Leather Tanning, Replacing Egg Yolk in........VI 284
Lactate of Lime in Baking Powder.....................XI 515
Leather, To Prevent Bleeding of Mineral-Tanned....IX 423
Mercury Nitrate in the Preparation of Nitro-phenols..VII 334
Metals from Fused Salts, Electrolytic Reduction of..VIII 368
Metal Soaps for Waterproofing..........................X 470
Naphthalene Purifying ....XII 561
Nitro Cellulose Waste Used in Paint Composition....IV 189
Paracoumaron Resin in Flake Form....................XI 514
Phenanthrene, Uses for..................................VIII 369
Phenol Condensation Products in Motor Brake Linings..XI 518
Phosphoric Acid by the Electric Furnace............IV 189
Phosphorus, Non-Fuming................................XII 561
Photographic Film ....X 468
Propylene Alcohol, Sawdust to Separate Hydrocarbons from ....V 237
Recovery of NO_2 from Dilute Nitrous Vapors........XII 560
Reduction, Improved Procedure of.....................XII 560
Selenium Oxychloride to Activate Charcoal...........IX 422
Sludge Acid, Recovery of, in Petroleum Refining.......X 470
Sodium Carbonate of Salines, Purifying.............VIII 367
Sour Milk Beverages, Improvement in................VI 286
Spent Fuller's Earth, A Black Pigment from.........X 468
Sulphur, Efficiency in Handling.......................VIII 366
Sulphur from Petroleum, Removing....................V 238
Sulphur Trioxide in Liquid SO_2 as a Sulphonating Agent, VIII 369
H_2SO_4 in Oil Refining, Recovery of.....................V 236
Resin, Synthetic, in Lacquers..........................IV 189
Synthetic Resins, Washing...............................V 237
Tartaric and Related Acids from Starch..............IX 421
Titanium Composite Pigments..........................V 236
Tungsten, Recovery of ....IV 189
Twitchell Reagent, Improved............................VI 284
Urea from Lime Nitrogen (Calcium Cyanamid).....VII 334
Vanadium Recovery of ....VI 284
Vegetable Albuminoid Food ....X 469
Vulcanized Plastic Coating ....XII 560
Zinc Dust ....IX 423
Zinc Salts, Purification of Recovered.................V 236
Zinc Dust, Recovery of, as Zinc Oxide.................X 470
Zirconium Ore, Purification of........................XI 514
Patents, Relation of Employer and Employee as Regards Ownership of. By Maurice Block, Member, New York Bar....V 201
Patent Situation Abroad. By Alfred Müller, Member, American Patent Law Association.........................X 441
Personal Items, I 47, II 95, III 143, IV 191, V 239, VI 287, VII 335, VIII 371, IX 424, X 471, XI 519, XII 563
Petroleum Technology, Avenues of Development and Increased Efficiency in the Conservation Distribution and Use of Petroleum and Its Products. By Dr. Van H. Manning, Director of Research, American Petroleum Institute ....IV 161
Petroleum Cracking Patent Infringement.................VIII 364
Phenolic Electrical Insulating Material..................XI 495
Phosphoric Acid Production for Fertilizer and Food Purposes, Progress in. By W. H. Waggaman, Scientist in Fertilizer Investigations, Bureau of Soil, U. S. Dept. of Agri. ....VII 302
Potash Industry, Rise and Fall of the Domestic. Illustrated III 134
Potato Flour, Manufacture of White. By W. A. Noel, M.E., Associate Development Engineer, Office of Development Work, Bureau of Chemistry, U. S. Dept. of Agri. ....IX 381
Prestige, A Cheap Way to Make ....IV 172
Progress in Human Engineering. Discussion of Principles of Trite Application to Present Problems of Industrial Chemistry. By Dr. Walter Dill Scott, President, Northwestern University. Illustrated ....IV 151
Prohibition Law Enforcement, Aspects of. By R. A. Haynes, Federal Prohibition Commissioner ....IV 165
[illegible] XIII 13, [illegible] V 11, Proverbs II 11 ....IX 380
Pulverulent Shortening Agent.............................XII 558

R[illegible] ....IX 10, X 110, XI 40, XII [illegible]
[illegible] ....X [illegible]
[illegible] ....XII [illegible]
Research Fellowships in the Agricultural Use of Sulphur.... VI [illegible]
[illegible] ....VII [illegible]
[illegible] ....[illegible]
[illegible] ....X [illegible]
Salaries in the Bureau of Standards, Scientific Training and.. I 8
[illegible] ....III 115
[illegible] ....II [illegible]
[illegible] in the Salt Industry. [illegible] Illustrated I 17
Sauer Kraut and Pickles, The Bacteriology of. By Dr. Edwin Le Fevre, Microbiological Laboratory, Bureau of Chemistry ....I 34
Saw Dust, Limitations of, As a Chemical Raw Material.... IV 176
Science vs. Economics.................................... VII 320
Selling Research By C. E. Skinner, Asst. Director of Engineering, Westinghouse Electric & Mfg. Co.......... IV 168
Sigma XI. A Society for the Promotion of Scientific Research I 33
Silica, Production and Industrial Uses of. By Raymond B. Ladoo, Mineral Technologist, U. S. Bureau of Mines.... II 77
Silicate of Soda in Flakes. Illustrated.................... II 58
Silicate of Soda in Flakes. By D. M. Goetschius, Engineering Chemist .... III 102
Silicate of Soda. Its Function in the Cleansing Process. Expansion of Its Use as a Detergent. By James G. Vail, Chemical Director, Philadelphia Quartz Co...............I 19
Silk Industry, American Artificial........................ III 110
Silk Manufacture, Activity in.............................VII 298
Slate as a Filler, Utilization of Waste. By Oliver Bowles, Mineral Technologist, U. S. Bureau of Mines.......... I 37
Solid Absorbents in the Natural Gas Gasoline Industry. By George A. Burrell, Consulting Petroleum Engineer...... IV 154
Solvent Extraction in the Production of Oils and Fats. By Ludwig A. Thiele, Ph.D., Consulting Chemical Engineer. II 65, VII 328
Solvent Extraction in the Production of Oils and Fats. By R. A. Bellwood, M. I. Mech E., Rose, Downs & Thompson, Ltd. .... VII 328
Soy Bean Industry in Illinois.............................. VII 308
Standardization and Cheaper Goods. By Charles le Maistre, Secretary, British Engineering Standards Association. VII 327
Standardization in American Industry, To Promote. Reports of the Committee on Foreign Commerce and the Revenue Laws of the Chamber of Commerce of the State of New York .... XI 482
Standardization of Chemical Analysis by Agricultural and Food Chemists .... XI 504
Standardization from the Consumers' Point of View. By N. F. Harriman, Engineer-Physicist, U. S. Bureau of Standards; Technical Secretary, Federal Specifications Board.......X 461
Standardization of Enameled Wares for Chemical Purposes. By Emerson P. Poste, Director of Laboratories, Enameled Products Co. Illustrated..............................X 435
Standardized Laboratory Apparatus......................... XI 486
Starch, Improved Laundry.................................. III 142
Steel Belt in Material Handling. By Harry Carlson, Sales Manager, Sandvik Steel Co., Inc. Illustrated......... IX 419
Sugar Industry, American................................. VIII 352
Sulphur, American, in the World's Markets............... XII 534
Sulphur and Pyrites Production............................V 231
Sulphuric Acid Concentration, Cascade System of. By Ludwig A. Thiele, Ph.D., Consulting Chemical Engineer. Illustrated .... VI 279
Sulphuric Acid, Concentration of. By Peter S. Gilchrist, President, Chemical Construction Co. Illustrated...... VI 257
Sulphuric Acid Manufacture Without Chambers and Towers. Illustrated .... I 39
Sulphuric Acid Production, Increased Capacity in. By Dr. Charles H. MacDowell, President, Armour Fertilizer Works. Illustrated................................... II 83
Sulphuric Acid, Safe Practice in Handling. By Donald C. Grenfell, New Jersey Zinc Co .... III 114
Sulphuric, Nitric and Mixed Acids, Production of........... XI 481
Sulphite Cellulose Extract, Use of, to Fill Sole Leather....VIII 364
Synthetic Resin in Chewing Gum........................... II 56
Tank Cars for Transportation of Muriatic Acid. By J. M. Rowland, Chief Engineer, Hooker Electrochemical Co. Illustrated .... VII 299
Technical Counsel, Cooperative Buying of................ II 66
Technical Photographic and Microscopical Society........... V 223
Technical School, Service of the, to Industry and the People. Enterprise of the School of Chemistry, North Dakota Agricultural College, in the Promotion of Technology and Sound Merchandising in the Paint and Varnish Industry and in the Education of the People in the Quality of Its Products. By Dr. W. T. Pearce, Head, School of Chemistry, North Dakota Agricultural College; Paint and Varnish Chemist, North Dakota State Laboratory. Illustrated....X 439
Technical Societies of Cleveland, Council of Associated..... VII 295
Technical Societies of Detroit, The Associated.............. I 4
Technically Trained Man, Relation of the, to the Promotion, Organization and Development of Industry. By L. W. Wallace, Executive Secretary, The Federated American Engineering Societies. Illustrated...................... II 81
Textile Research.. II 68
Trade Association Activity, Limitations of. By Gilbert H. Montague, Member, New York Bar...................... II 64
Trade Associations, The Field and Functions of, in American Industry. By Herbert Hoover, Secretary of Commerce. Illustrated ....V 193
Trade Associations, The Place of Scientific Research in the Programme of. By Edwin R. Weidlein, Director, Mellon Institute. Illustrated ....VI 241
Trade Associations, U. S. Bureau of Mines and. Illustrated. VII 318
Vat Dye Raw Materials, Status of Domestic. By C. J. Thatcher, Ph.D., Vice-President and Technical Director, [illegible] Co., Inc. Illustrated ....IV 187
Vitamins and the Future of Margarin Manufacture. By Dr. Casimir Funk, Associate in Biological Chemistry, College of Physicians & Surgeons, Columbia University; Director, H. A. Metz Research Laboratory. Illustrated ....V 227
Vitamins in Food ....VI 276
[illegible] Illustrated ....VII 273
W[illegible] ....VII 297
Water for Steam Making, Treatment of. By Julian S. Simsohn, [illegible] ....I 43
Water Supplies, Centralized Softening of Public, for Industrial and Potable Purposes. By S. C. Hadden, Editor, Municipal and County Engineering ....VIII 349
[illegible] ....VI 268
[illegible] ....VII 292
Yeast, Fermentative Properties of Good ....IX 376
Yeast Manufacture, [illegible] ....VII [illegible]

TP
1
C32
v.30
[redacted]

Engineering

Chemical age

PLEASE DO NOT REMOVE
CARDS OR SLIPS FROM THIS POCKET

UNIVERSITY OF TORONTO LIBRARY

ENGIN STORAGE